ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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What in the World!

Preceded by fanfares and viewed with appreciable alarm, the Institute of Public Engineering met last week for its first and perhaps only session. Sponsored by the New York State Power Authority, it tackled the topic of electricity distribution costs. Results involved an intelligent and fair presentation by the lay brothers with little benefit of utility clergy. Something started that may lead to further industry advancement (p. 116).

●

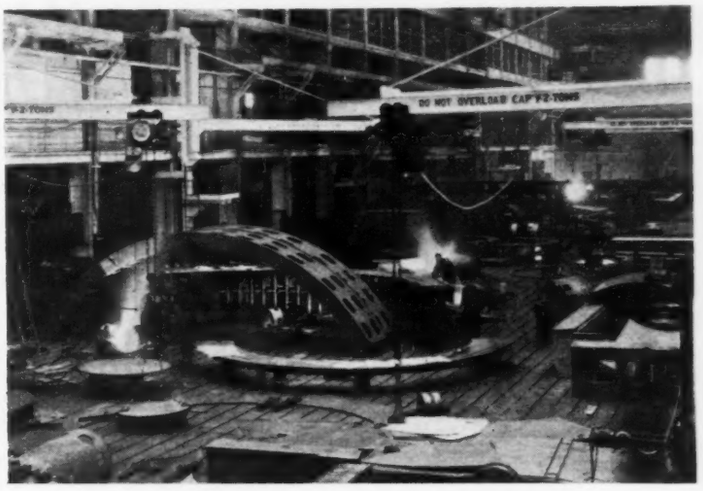
There may be aid and comfort for the technocratically inclined in W. B. Flynn's statement (p. 138) that with power-driven aids a 132-kv. H-frame transmission line can be built for $6,000 a mile today. We choose to view it as evidence of continued advance in the art and in the reduction of costs of service.

●

Convention days are busy ones for the editors. This week we have been at the A.I.E.E. meeting in New York sharing with each other the interpretation of each session that next week you may have our best guess as to what the significance of individual sessions and papers may be. Incidentally, there is the necessarily briefer account of convention high lights this week (p. 113).

●

What a beating the Code has taken in the past few years! Mr. Walsh, with coldly imperturbable figures, shows that in home use in his territory the maximum percentage of actual to Code demand is 65.4 per cent, the minimum 34.4 per cent, and concludes requirements which allow no diversity factor for either one or two appliances of more than 1,650 watts rating to be unduly stringent (p. 124).



Fabricating turbine frames by electric arc welding

JANUARY 28, 1933

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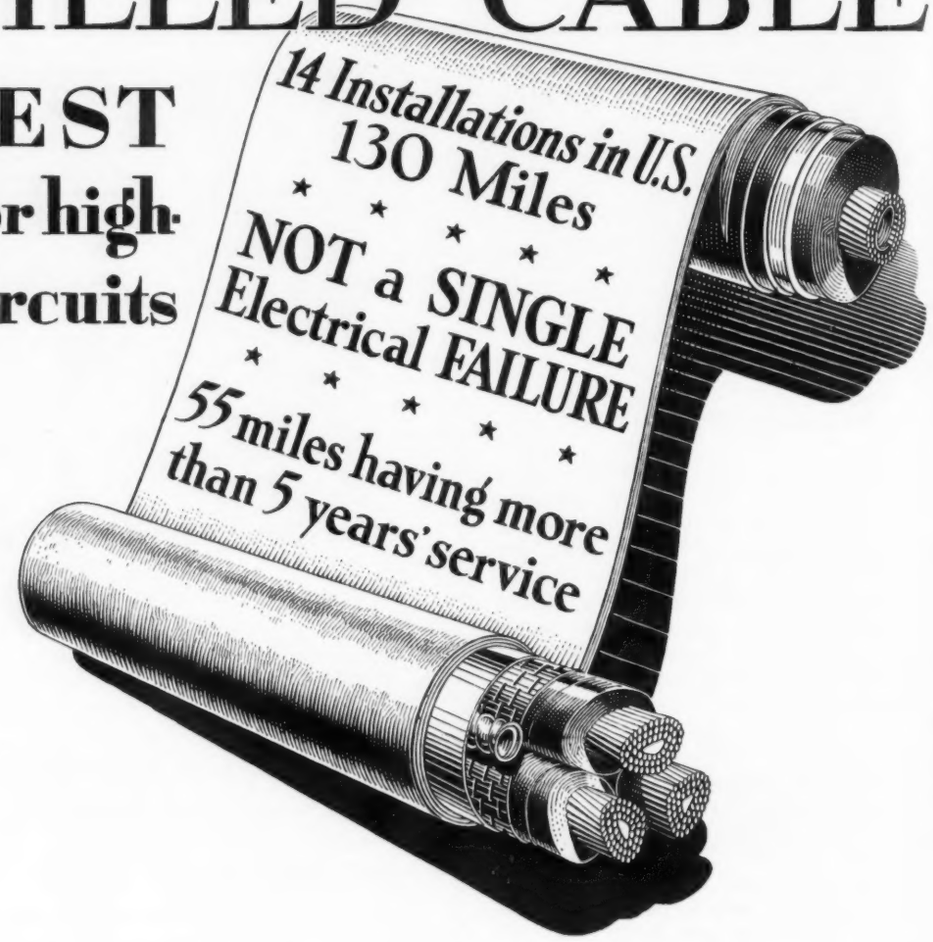
This RECORD *proves that* OIL-FILLED CABLE

is the BEST CABLE for high-voltage circuits



OIL-FILLED cable will justify every bit of confidence you put in it—because of this record:

Fourteen commercial installations of oil-filled cable — 130 miles — have been made in the United States in the last six years by all manufacturers.

Fifty-five miles of this cable have been in service for more than five years.

And in all these installations, and during this long-time service, there has not been a single electrical failure.

Hence, you can accept this statement at its face value: oil-filled cable is the best cable for high-voltage circuits.

The best, because it has proved to be the most economical, the most efficient, and the most reliable cable.

RECOMMENDATIONS

The following recommendations of the General Electric Company are given to clarify what is meant by "high-voltage circuits."

Single-conductor Cable

Recommended for circuits of voltages above 60 kv. Can be manufactured and guaranteed for any voltage circuits up to 220 kv.

Three-conductor Cable

Recommended for circuits of voltages above 35 kv. Can be manufactured and guaranteed for any voltage circuits up to 69 kv.

ASSURANCE OF SUCCESS

This statement — that oil-filled cable is the best cable for high-voltage circuits — is made to increase your confidence, the public's confidence, in a worthy product. Accept it as assurance that you can go ahead with any project involving the use of oil-filled cable with every certainty of success. General Electric Company, Schenectady, N. Y.

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GENERAL ELECTRIC

ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

January 28, 1933

Continued Engineering Progress Reported at A.I.E.E. Winter Convention

- Many advances in the art developed despite depression curtailments
- Welding technique improved
- Better mercury arc rectifiers
- Emphasis on reliability and operating economies of equipment
- Prizes awarded Bancroft Gherardi and Frank M. Starr

THOUGH depression days have sapped the vitality from many a manufacturer's balance sheet and drastically curtailed research and development allowances progress in the art of electrical engineering still goes on. Those attending the annual winter convention of the American Institute of Electrical Engineers in New York this week observed the encouraging results of persistence under economic difficulties.

No fear of machine age

As reflected by the tone of their own discussions engineers are concerned about society's estimate of them, but judging from the temper of the sessions of the A.I.E.E. convention they firmly believe they are entitled to approbation rather than blame. No more impressive assembly of the engineering contributions on the part of one man has been recounted lately than was enumerated by Gano Dunn, who told why Bancroft Gherardi, vice-president of the American Telephone & Telegraph Company, was being given the Edison Medal of the Institute. Just to mention a few, he had started as a cadet engineer by discovering the cause of cable sheath corrosion in iron pipe ducts; adoption of transmission norms for the respective telephone circuit classifications, the institution of the A-B board system in operation, the great reduction in order circuits required for supervising trunk lines, adaptation of the Pupin coil to continent-wide transmission, etc. As a proof of his courage and capacity for organization he had successfully moved a large telephone exchange to a new site—building, apparatus and operators—without interrupting service.

Other discussion of the engineer's assumption of a proper place of service, direction and responsibility in the social order was embraced in the educational session. R. I. Rees outlined the program of the Engineers' Council for Professional Development, which aims to shape engineering education, professional association and public practice of engineering into a co-ordinated plan that will insure adequate recognition of the individual and of the profession as a whole.

Again, wholly incidental to one of the technical sessions, J. A. Noertker passed off the reading of his paper with the remark that all he really needed to say was that automatic stations and supervisory control had afforded a perfect transportation record to the Cincinnati railways. He then proceeded to uphold the introduction of automatic equipment in spite of the fact that it usually resulted in displacement of both labor and capital without compensation or immediate alternative employment. He advocated establishment of reserve funds to tide labor over when employment shifted. Such a charge against the superior earning capacity of labor-saving equipment would remove the injustice due to technical advances. This same topic, technology in the social order, was the subject of an address by Dr. J. C. Merriam, president of Carnegie Institution at Washington, who, in tracing the "Evolution of Society as Influenced by the Engineer," said much of our trouble was due to the lack of the engineer's respect for facts rather than fancies on the part of the populace and those whom they elected blindly to lead them. Technocracy was virtually a taboo word with those who addressed the sessions.

Power units improved

In all there were fourteen sessions. Such as are not reported here will be dealt with comprehensively in next week's issue of ELECTRICAL WORLD. At least two new items of equipment were announced or intimated and attracted attention. One is the development of a self-excited commutator type low-frequency generator, the supply from which has desirable characteristics for paper-mill drives, reversing service, screen shakers, etc. Another development which attracted much notice was the announcement by Messrs. Slepian and Ludwig that they had discovered a simple adjunct to the mercury arc which affords positive control of the arc, improves efficiencies and greatly reduces arc volume and therefore the dimensions of the rectifiers.

Welding

Further inroads upon some of the "mysteries" of the electric arc were discussed at the welding session, where the practical value and control of transients in welding generators were also considered. In reporting upon investigations of the high-velocity vapor stream in vacuum arcs R. C. Mason pointed out that they may have something to do with the effectiveness of an arc in welding. An energy analysis of the arc was submitted by J. L. Meyer, who showed that the higher the temperature, the higher the efficiency. The value of a directed field was also indicated. A 900-cycle double-inductor generator capable of supplying several arcs simultaneously was discussed by G. A. Johnstone, who claimed many merits for it.

Fundamental approach to system planning of power supply for electrified railroads and operating results obtained at the Cleveland terminal constituted two papers which were received with special interest at the transportation session.

Air-conditioning requirements for railroad passenger cars, said W. C. Goodwin and Charles Kerr, Jr., can be met with 6 tons refrigeration capacity per car and a 12-hp. motor driven from a 15-kw., 32-volt axle generator coupled with an 800-1,000 amp.-hour battery. Precooling can be handled by a separate 220-440-volt, 60-cycle motor connected to station or terminal circuits.

Tap-changing speed-control, as described by W. A. Giger, requires only two contactors mechanically interlocked with the tap changer, little space on top of the transformer and little cable connection as the tap-changer is connected directly with the transformer taps. Tests presented on one locomotive showed a fluctuation in draw-bar pull during acceleration of only 24 per cent compared with 55 per cent for preventive-coil control.

Industrial applications

Recent applications of electronic devices for industrial control constituted the outstanding feature of the industrial applications session, which also devoted attention to circuit breaker protection of industrial circuits and variable-voltage oil-well drilling equipment.

Industrial applications of electronic tubes has been given added impetus by perfection of high-current vacuum and grid-glow tubes, declared F. H. Gulliksen. Several installations indicate their superiority over conventional electromechanical equipment, he said, but they are particularly adapted to performing functions that cannot be accomplished by conventional controls and where high sensitivity and quick response are paramount.

Insulation co-ordination

Insulation co-ordination, impulse testing, protection of static and rotating equipment against transients and rectifier developments attracted a large attendance. Agreement has been reached by the transformer subcommittee on a tentative test procedure for impulse testing of commercial transformers, reported V. M. Montsinger and F. J. Vogel, although there is not yet complete agreement on all details. Equipment for testing, methods of applying tests, type of wave, tests to be applied and methods of detecting failures were suggested.

Results of impulse voltage testing conducted in co-operation with the Utilities Research Commission of Chicago and reported by C. F. Harding and C. S. Sprague brought forth the interesting conclusion that, with the usual conditions encountered in metropolitan work, interconnection of transformer arrester grounds with the secondary neutral limits transformer stresses under lightning conditions may be held to a practically negligible value even with the old non-surge-proof transformers.

D. W. Roper reported that by connecting lightning arrester grounds to secondary neutrals on 15 per cent of the transformers in Chicago, serving about 100,000 customers, no adverse results had been obtained and transformer failures had been reduced 40 per cent. He urged that the A.I.E.E. seek revision of the National Electrical Code to allow such practice.

Nobel prize to Starr

Awarded only once previously, and on that occasion to a mining engineer, the Alfred Nobel Prize of the American Society of Civil Engineers went this year to Frank M. Starr of the General Electric Company (Schenectady) for his paper "Equivalent Circuits." Its contribution to the advancement of engineering by a young engineer won the vote of the joint committee because it presented a new method for handling the previous intangibles that had prevented extensive and intricate networks being set up with precision on calculating boards.

Registration of members and guests totaled something over 700.

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Brooklyn Edison Denies Labor Policy Charges

Making blanket denial of all allegations and challenging the jurisdiction of the New York Public Service Commission, the Brooklyn Edison Company has filed with the commission its answer to a complaint against its labor policies made through Jerome Count, counsel for the National Committee on Utilities and Labor. The committee has announced that it will call upon the newly organized Edison Electric Institute to refuse membership to or take disciplinary action against the Brooklyn Edison for its opposition to public hearings and a full investigation of the complaint.

The complaint charged that the power company "unlawfully, unreasonably and unjustly" discharged 5,000 employees, that its labor policies tend to "incite violence and civic disturbance" and that it is saving $7,500,000 yearly in wages while electric rates remain at the same level and excessive dividends are being paid.

Asserting that the public service commission law gives the commission no jurisdiction "in this matter" and that action by the commission would constitute "unlawful interefence with the internal corporate management" of the company, Brooklyn Edison contends in its answer that the allegations "would not justify the expense which would necessarily be incurred by public hearings or examination." The answer adds that the company has not discharged any employees except when necessary.

▼

New York Hearings Close on Radical Meter Rule

Whether approach to perfect accuracy of all meters would be attained by working to a tolerance of 2 per cent entirely on the minus side or to a tolerance of 1 per cent plus and minus was practically the sole point of contention in the closing hearing on January 18 on the matter of the amended watt-hour meter rules of the New York Public Service Commission. Utility witnesses argued for a bilateral tolerance in keeping with the fundamental theory of probability as applied to accuracy in all kinds of measurement. All documentary evidence of this ruling principle as applied to ordinances on scales, bread, milk bottles, taxi meters, etc., was, however, excluded by the commission as irrelevant.

That adherence of the commission to the proposed unilateral tolerance would result in a reduction in revenue or an unjustified increase in testing expense to prevent revenue loss was urged strongly by the utility witnesses, but without apparent avail. Briefs will be filed and in the event of an adverse decision the rule will probably be tested by appeal to the courts because of its importance in principle. Equivalent provisions have already been promulgated in rules for water and gas meters as mentioned in the previous news items (December 10, page 769, and December 24, page 840).

▼

Loss of L'Atlantique Laid to Type of Wiring System

Because of its bearing on the provisions of the National Electrical Code at least one result of the investigation into the burning of the great French liner L'Atlantique is of interest. It emphasizes the distinction between the effects of short circuits and grounds on metal-sheathed wiring in steel structures. The most striking discovery so far made at the judicial inquiry being held at Cherbourg is that, although fireproof doors were closed immediately after the discovery of the outbreak, another cabin which should have been protected by this action burst into flames soon afterward. This discovery is held to support the view generally accepted in France that the rapid spread of the fire as well as its origin was due to defective electrical fittings.

In an attempt to find a possible explanation of the disaster some electrical experts have carried out experiments

for the inquiry. They arranged a series of circuits wired in the manner prescribed by the regulations; that is to say, with the wires individually insulated, sheathed in metal and further insulated by battens of wood at suitable distances. Using a ground return they found that by producing a short circuit it was possible to heat the metal sheaths —not the wires themselves—to the point where the wooden battens burst into flames, not merely at one point but at many.

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Further Economies Discussed by Apparatus Committee

Practical discussions of ways in which economy programs may be made more effective without impairment of service dominated the two-day meeting of the N.E.L.A. apparatus committee in Philadelphia last week. Constantly recurring were the themes of getting the greatest use out of the dollar invested and of the elimination of unnecessary expenses and requirements. An analysis of the characteristics and causes of recent oil fires in generating stations was also a feature.

Necessity of balancing the costs and benefits of code requirements was emphasized in discussing proposed code changes and requests for revisions. Comparisons of the expense of inspection and maintenance work with the possibilities of breakdown has induced many companies to depart from arbitrary schedules, unwarranted in the light of experience, and thereby effected savings as high as 50 per cent and $15,000 a year without impairment of service, it was reported. Modernization of oil circuit breakers on one property brought a maintenance saving of 50 per cent.

To minimize delays in fighting lubricating oil fires it was suggested that, by applying full field plus a loaded exciter as brakes, the spinning generators may be stopped more quickly and thus make it possible to shut down auxiliary oil pumps which may be pumping fuel to the flames. Insulating oil fires are seen as involving an old problem which needs but to have the proved and effective solutions applied to old stations which may have more hazards now than when originally built due to the increased quantity of oil required for increased capacities and voltages.

A new compact low-cost capacitor of the electrolytic type was mentioned as available for fractional-horsepower motors for about $6 per kva. net. This unit will withstand 7 per cent overvoltage and reseal upon breakdown.

About 80 per cent of the motor outages can be prevented by installing delayed-action undervoltage relays which function only when the voltage drop attains 25 per cent or more, it was contended. The major question today was cited as, "should such relays have fixed or adjustable time delay and limitations on the undervoltage at which they function?" Strong opposition to the existing N.E.M.A. basis of rating fuses was voiced, it being claimed that the rating indicates neither continuous carrying capacity nor rupturing ability.

The next meeting of the committee will be held in Chicago in April, at which time it is expected to present a serial report on preventing, isolating and fighting oil fires.

Threats of Inflation Return

Lively but unlikely to be substantiated fears that America is about to embark on a mad career of inflation followed the remarks of Senator Borah early this week. Foreign exchange, especially the pound, showed notable strength and reflected the reaction of both the speculative and the timorous to the familiar threat which rose to no better purpose last spring. That there will be a strenuous fight for inflation of the currency is probable; that it will succeed, in the sense of a flight by America from the gold standard, is beyond the range of present probabilities.

Such scares accomplish just about what the less extreme inflationists desire in diverting funds from bonds and deposits to commodity and stock holdings. The incoming administration appears to be committed to the cause of inflation only to the extent of credit expansion and not to the debasement of the currency. Nevetheless, there will be a bitter fight.

Figures of the week are far from indicating a clear-cut status. Energy production shows a seasonal decrease. Carloadings have risen by 70,670 units over the first week of the year, holding a nominal level sustained since November. Coal production has tapered off. Commodity prices are at a new low for the depression. Security markets sag. The speculatively inclined sense as inevitable a confidence-building show to be put on around March 4, but look for a market rally of no more than minor proportions.

Discredited and disrupted though technocracy became this week, when Nicholas Murray Butler read the meteoric career of Howard Scott out of the sedate halls of Columbia, the mischief of spreading a blanket of fear over a world that desperately needs courage has been done. There is no harking back to the stone, paleolithic or middle ages, though we could advantageously regain a payasyougoic age; in fact, we probably shall.

Lubricating Oil Fire Damages Jersey Station

Fire which followed the breaking of a lubricating system oil pipe damaged the recently installed 18,000-kw., 3,600-r.p.m. turbo-generator at the modernized 53,000-kw. Burlington, N. J., station of Public Service Electric & Gas Company on Monday of this week. The turbine was partially enveloped by flames, which persisted for some time despite the efforts of company employees and city fire-fighting forces. The casing is thought to have been warped by the heat and possible internal damage may have occurred, but this can only be determined by full examination later on. Structural elements in the station were also damaged by the heat.

According to official advices, the turbine, which had been removed from service on December 15 for examination and adjustments, was restarted last Saturday night and subsequently developed a vibration, which presumably led to the rupture of a pipe carrying lubricating oil to the unit. Upon the breakage of the pipe the escaping oil ignited, possibly induced by the heat of the surfaces with which it came in contact. None of the other generating units in the station appear to have been damaged badly, combative efforts confining the flames to the general area of origin.

Service was interrupted only to the Burlington area, served by two substations, for about nine minutes, energy being drawn from other generating stations of the company to provide for the deficiency due to the troubles at Burlington.

The turbo-generator is an 18,000-kw. unit operating under a steam pressure of 650 lb. per square inch and at a temperature of 850 deg. It was the first high-pressure unit to be installed by Public Service and is one of the few 3,600-r.p.m. units to have been built (ELECTRICAL WORLD, April 16, 1932, page 681).

▼

United Corporation Status as of December 31, 1932

		Compared with 1931 Per Cent
Income		
Income	$14,832,917....	—23.4
Interest paid	566,767....	+18.8
Expenses ..	441,962....	—6.0
Balance available for dividends	13,824,187....	—25.0
Balance to Surplus ..	546,930....	+12.1
Balance Sheet		
Value of investments* ...	$592,821,863....	Negligible Change
Current assets ...	724,673....	—34.9
Current liabilities	11,672,000....	—7.3
Funded debt	None....	
Reserves ...	47,772....	—5.0
Surplus	384,717,543....	Negligible change

*Estimated market value Dec. 31, 1932, $272,256,212; Dec. 31, 1931, $269,405,996.

Coming Meetings

Conference on Economics of Applied Lighting—Cleveland, Ohio, Feb. 8-9. J. M. Ketch, Case School of Applied Science, Cleveland.

Middle West Division, N.E.L.A.—Engineering conference, Kansas City, Mo., Feb. 10-11. Thorne Brown, 1527 Sharp Bldg., Lincoln, Neb.

Great Lakes Division, N.E.L.A.—Fifth annual sales conference, Chicago, Feb. 16-17. T. C. Polk, 20 No. Wacker Drive, Chicago.

National Accounting Section, N.E.L.A.—Committee meetings. Chicago, Feb. 20-21. A. J. Marshall, 420 Lexington Ave., New York.

New England Division, N.E.L.A.—Engineering Section, Boston, Mass., March 2-3. O. A. Bursiel, 20 Providence St., Boston.

Oklahoma Utilities Association — Oklahoma City, Okla., March 7-8. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City, Okla.

National Sales Section, N.E.L.A.—Committee meetings, Chicago, March 21-23. A. J. Marshall, 420 Lexington Ave., New York.

National Engineering Section, N.E.L.A.—Committee meeting, Detroit, Mich., April 10-14. A. J. Marshall, 420 Lexington Ave., New York.

Maryland Utilities Association—Baltimore, Md., April 21. D. E. Kinnear, 803 Court Square Bldg., Baltimore, Md.

Missouri Association of Public Utilities—Jefferson City, Mo., April 27-29. N. R. Beagle, 101 West High Street. Jefferson City, Mo.

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New Government Power Plan to Include Muscle Shoals

Following an inspection of the Muscle Shoals plants with Senator George W. Norris of Nebraska, chief advocate of governmental operation, and a party of Senators, Representatives and newspaper correspondents, Franklin D. Roosevelt, President-elect, in a speech on the portico of the Alabama State Capitol in Montgomery declared that he would take steps to put in operation the government-owned power and nitrate plants at Muscle Shoals soon after his inauguration. He said in part:

"I visioned two things: First, putting Muscle Shoals to work; second, the making of Muscle Shoals a part of an even greater development that will take in all the Tennessee River from the mountains of Virginia to the Ohio and the Gulf. . . ." That a broad new power program is under consideration was also evidenced in his addresses at Sheffield and Florence, between which the dam is located, and at Decatur. "I am confident that with the aid of these distinguished gentlemen in Congress," he said, "we will be able to get something done. The development here is national and is going to be treated from a national point of view. It is going to be my purpose to put Muscle Shoals back on the map. I expect to come back here at no distant day and to see this great development in operation. . . ."

The Norris bill, already passed by the House, follows the lines of the Senator's preceding bills and provides for the sale of power to municipalities, counties, states and farm organizations at rates to be fixed by the Federal Power Commission if satisfactory contracts cannot be made with private companies. Senator Norris believes that the nitrate plants should be run as government experimental stations for the manufacture of fertilizers.

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Electrical Distribution Costs Discussed by Institute of Public Engineering

"EXPLORATION into the virgin territory" of electrical distribution cost analysis, as Prof. J. C. Bonbright characterized the purpose of the three sessions of the Institute of Public Engineering in New York City on January 20, resulted in the release of a great amount of new and varied data on this subject. Several speakers decried the fact that practically the only vehicles of such information in the past have been the pages of ELECTRICAL WORLD or the St. Lawrence power distribution cost survey and then each proceeded to contribute his mite and might to the cause.

Speakers and audience there totaled more than 200 from the breadth and length of the continent, with municipal and Canadian, consulting, commission and utility engineers presenting papers, the latter, by choice or otherwise, much in the minority. Any layman would have gained from the sessions the first impression that generation, transmission and substation costs are universally close to 1.5 or 1.7 cents and that distribution costs amount to 2.36 cents or thereabouts, making the total approximately 4.0 cents for the kilowatt-hour at the customer's service entrance. Chairman Maltbie of the New York Public Service Commission facetiously but seriously regretted that averages should be given such prominence even though those who participated in the program had almost universally cautioned against the acceptance of national or regional averages where all the facts of the case pointed to the absolute necessity of recognizing elements of system design and management policy which cause distribution costs for residence customers to spread all the way from less than 1 cent to 8 and even more cents per kilowatt-hour.

Hudson W. Reed of Philadelphia (U.G.I.) had enumerated these factors in great detail in his paper and the municipal and consulting engineers had stressed them in their presentation of data. The most exhaustive analysis was presented by Clayton W. Pike, who, under the auspices of the Power Authority of the State of New York, had broken down the reports of the New York utilities to the Public Service Commission. The defects in the uniform classification of accounts for such an application made necessary the determination and assumption of technical averages of wire length per customer, transformer sizes, customer densities, etc., in order that the desired result might be obtained. As shown in the accompanying chart, Mr. Pike found a New York general average cost of 2.36 cents per customer. George E. Goldthwaite went further in discussion, taking three companies (small compact city, town-village-rural, large city), and showed a spread of distribution cost from 2.2 to more than 6 cents for residence usage averaging 479-623 kw.-hr. per year.

Investment in Poles, Arms & Insulators $15.00 per Customer
Share of Investment in Line Transformers $6.50 per Customer
Investment in Meters & Services $15.00 per Customer
Investment in Overhead Wires $13.00 per Customer
Interest or Return on Investment Calculated at 7% 29.6%
Depreciation 2.5% of Investment 10.8%
Taxes & Insurance 2% of Investment 8.4%
Share of General Investment $3.50
Total Investment - $55.00 per Average Residence Customer Fixed Charges - 48.8% of Total Cost - $6.35 - $.0115 per K.W.H.
Cost of Distribution is $13.00 per Year or 2.36¢ per K.W.H. for 550 K.W.H. per Average Residence Customer
Operating & Maintenance - 51.2% of Total Cost - $6.65 - $.0121 per K.W.H.
Direct Operating & Maintenance 95% Distribution System Operation & Maintenance
$2.00 per Customer
2.50 per Customer Substation
3.81%
Work Done for Others (Miscellaneous Credits)
$1.80 per Customer Commercial Meter Reading, Billing, Etc. 14%
$1.25 per Customer New Business Cost & Securing 9.7%
Sundry Customer General Administration, Etc. 8.2%

R. E. McDonnell, with a background of experience in designing and building 260 municipal plants, showed a range of annual total expense per customer (exclusive of production which spread from 0.338 to 1.35 cents, from $6.23 to $27.30 for sixteen municipals and from $17.55 to $36.80 for eight private utilities. L. V. Buchanan of Hamilton, Ont., introduced the concept of "permissible load factor" for fixing class costs and rates. In the discussion of this paper and the reasons for the low costs cited

it was emphasized that low rates tend to make the resultant heavy usage a much greater determinant in distribution costs than customer density or individual system characteristics. Fixed charges, an essential component of any residential cost analysis, were said by J. D. Ross of Seattle to be 5 or 6 per cent too high by reason of the refunding practice of the private utilities as against the sinking fund and redemption policy of the municipals.

As a whole the outstanding contribution of the meeting was the confirmation of the U. S. Supreme Court's "gateway" rate decision of January 9 in the Martinsville, Ind., case in which the substation becomes the point of division between production and delivery of energy. Rather than leading to uniformity of rates, it seems to provide the basis for differentiation in the field of distribution, where the differential elements principally reside.

The meeting was sponsored by Morris Llewellyn Cooke of the Power Authority of New York in execution of its mandate to ascertain distribution costs. There was a generous attendance of commissioners, especially from those states (New York, Pennsylvania, District of Columbia and New Hampshire) which had lent aid and sympathy to the movement.

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House Wiring Responsibility Is Utility's, Says Alabama

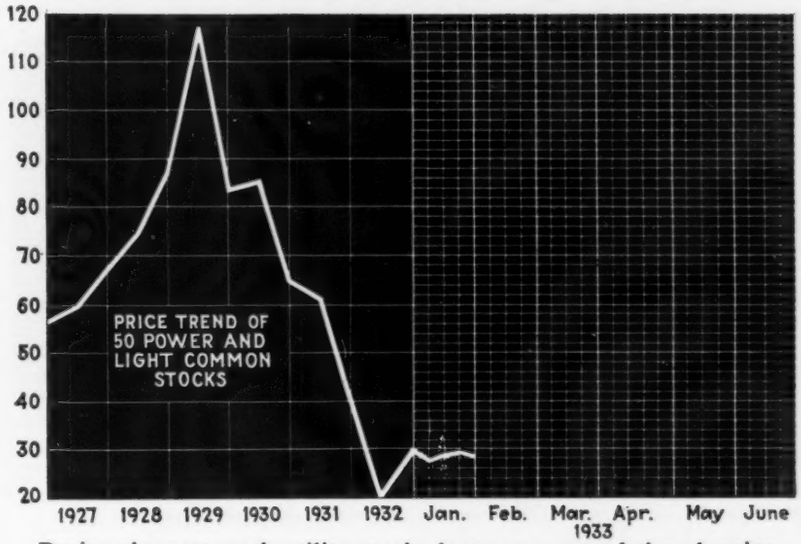
Responsibility for checking wiring in homes and buildings to see that there are no defects which might cause damage from lightning or other causes has been shifted to the shoulders of the utility by two recent decisions of the Alabama courts. The Supreme Court has affirmed a judgment for $9,500 damages against the Alabama Power Company for the death of a young girl in Henry County who was killed by lightning while sitting under an electric lamp in her home. At Carrollton, Ala., a merchant has obtained a judgment for $20,000 for injuries suffered when struck by lightning in his store.

Power company attorneys contended the company could not be held liable for damages because in one case the merchant himself had installed the wiring and had failed to provide a proper ground connection. In the other case it was shown a ground was lacking. The courts, however, took the attitude that the company was negligent in furnishing current in both cases for a number of years with the defects existing.

The larger cities provide inspection service on wiring jobs and electricians have to pass an examination. Such is not the case in small towns and in rural sections. These cases have illustrated the need for a state electrical inspector. To require the power company to inspect each wiring job before connecting service would put an enormous burden on it.

Utility officials are wondering just what the courts would rule in case it could be shown that a fire was caused by defective wiring.

Utility Stocks Lose Some Ground



During the past week utility stocks lost some ground though price changes were insignificant. The "Electrical World" index was 28.3, as compared with 29.3 in the preceding week.

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Current Earnings Reports of Electric Light and Power Companies

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Operating Companies					
Consolidated Gas, Elec. Light & Power Co. of Baltimore (11 mos. ended November 30)					
Gross earnings	$25,032,629	$25,949,843	—3.5	68	66
Net earnings	7,946,444	8,712 209	—8.8	..	..
Net balance	4,461,977	5,448,101	—18.0	..	..
Puget Sound Power & Light (Year ended November 30)					
Gross earnings	13,727,563	15,890,040	—13.5	61	62
Net earnings	5,421,180	5,989.331	— 9.5	..	..
Net balance	487,381	867,182	—43.9	..	..
Virginia Electric & Power (Year ended November 30)					
Gross earnings	15,587,146	16,997,875	— 8.3	64	67
Net earnings	5,602,788	5,683,682	— 1.4	..	..
Net balance	2,534,655	2,736,893	— 7.4	..	..
Holding Companies					
American Power & Light and subsidiaries (Year ended November 30)					
Gross earnings	$76,309,997	$85,064,169	—10.3	53	53
Income from subsidiaries	11,697,725	18,167,489	—35.7	..	..
Net balance*	£06,847	6,865,922	*	..	..
American Water Works & Electric and subsidiaries (Year ended November 30)					
Gross earnings	44,622,187	50,407,819	—11.4	56	57
Net balance	3,029,353	4,666,688	—35.0	..	..

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Holding Companies (Continued)					
Electric Power & Light and subsidiaries (Year ended November 30)					
Gross earnings	$74,133,774	$81,385,663	— 8.9	58	56
Income from subsidiaries	7,150,634	12,057,103	—40.7	..	..
Net balance†	198,799	4,990,521	—96.0	..	..
National Power & Light and subsidiaries (Year ended December 30)					
Gross earnings	71,943,734	78,413,683	— 8.3	60	61
Income from subsidiaries	9,973,086	12,084,482	—17.5	..	..
Net balance	1,700,151	3,796,067	—55.3	..	..
Public Service Corp. of New Jersey and subsidiaries (Year ended December 31)					
Gross earnings	125,833,707	137,259,454	— 8.3	66	67
Net balance‡	28,298,146	30,540,752	— 7.4	..	..

*Deficit.

†Balance available for second preferred and common stocks.

‡Balance available for preferred and common dividends.

Gross earnings — (Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings — Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Income from subsidiaries — Balance available from income of subsidiaries for holding company. Net balance — Balance available from income for common stock dividends.

Days Lengthen: Output Decreases

Dropping about two-thirds of a per cent from the preceding week, to an estimated 1,484,089,000 kw.-hr., according to the National Electric Light Association, the electrical energy output of central stations continues to be less than it was a year ago. In fact, the difference increased slightly, to 7.1 per cent against 6.7 per cent the week before. Apparently the winter peak arrived as usual in the third week of December. A gradual decrease as the days lengthen will be normal, even if the industrial load picks up.

Operations on the Pacific coast show a closer approach to the preceding year's than at any time during 1931, being down only 2 per cent. In other sections the disparity increased, particularly in New England.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1933	1932	1931	1930
January 21.....	1,484	1,598	1,713	1,826
January 14.....	1,495	1,602	1,717	1,834
January 7.....	1,461	1,619	1,714	1,816
	(*1932*)	(*1931*)	(*1930*)	(*1929*)
December 31.....	1,415	1,524	1,597	1,680
December 24.....	1,554	1,565	1,617	1,638

Per Cent Change from Previous Year

Region	Week Ended Jan. 21	Week Ended Jan. 14	3 Wks. Ended Jan. 7
Atlantic Seaboard.....	— 6.8	— 5.1	— 4.6
New England alone...	— 7.3	— 4.7	— 3.8
Central industrial.....	—10.8	—10.4	— 8.5
Pacific Coast.....	— 2.0	— 4.5	— 5.0
United States.....	— 7.1	— 6.7	— 5.9

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Condemnation Law Upheld by Nebraska Supreme Court

Over-ruling the objections of the Western Public Service Company to the naming of appraisers to fix the amount that the city of Mitchell must pay for taking over the company's Mitchell plant and distributing system (ELECTRICAL WORLD, December 10, page 776), the Nebraska Supreme Court has upheld the validity of the state law enacted in 1929, which gave to municipalities and electric energy districts the right to condemn the property of power companies.

The court maintains that the board of appraisers provided, though termed a court of condemnation, does not constitute a court as defined by the constitution and the laws, although the board exercises functions judicial in their nature; that it was competent, under the constitution, for the Legislature to designate district judges as a class from which appraisers would be chosen and to authorize the Supreme Court to select the judges to act as appaisers; that the law is not invalid because it does not provide for jury trial, since when the constitution was adopted there existed no right to trial by jury in cases involving the exercise of the right of eminent domain; that the act is not a special law regulating the practices of courts of justice prohibited by the constitution, and that in authorizing the appraisers to apportion costs and in requiring a cost bond and payment for a transcript as a condition of appeal, the act does not violate the equal protection and due process clauses of the federal constitution.

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Domestic Use Decreases; Wholesale Shows Gains

For the first time since monthly statistics have been collected on the electric light and power industry, and probably for the first time in its history, domestic consumption has fallen below that of the corresponding month in the preceding year. As reported by the National Electric Light Association, the use in November, 1,075,749,000 kw.-hr., was down 0.2 per cent from 1931. In October it was still up 1.0 per cent.

In contrast, the showing for large power and light (wholesale) was more favorable than it has been. Though still 13.2 per cent under the figure for the same month in 1931, the disparity has been decreasing. In August it was 24.8 per cent, but in September it fell to 19.8 and in October to 17.2 per cent.

In total kilowatt-hours sold to ultimate consumers of all classes, off 15.8 per cent from 1931 in August, the disparity fell to 11.8, 11.3 and finally to 7.8 per cent in November. In actual quantity, domestic sales have been increasing seasonally, but less than in 1931, while wholesale energy has held fairly steady in contrast with the previous year's marked decline.

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Electric Bond & Share Reports for 1932

(Year ended December 31)

		Compared with 1931 Per Cent
Income		
Income	$18,896,884....	—42.0
Expenses ..	5,330,218....	—29.0
Balance available for dividends ...	13,566,666....	—45.9
Balance to surplus.	3,624,450....	—55.9
Balance Sheet		
Value of investments*	..$504,972,424....	—2.7
Current assets ...	46,521,575....	+38.0
Current liabilities .	4,591,930....	—26.2
Funded debt ..	None....	
Reserves ..	5,717,570....	+18.9
Surplus ...	369,986,092....	+48.9

*Approximate market value Dec. 31, 1932, $166,384,000; Dec. 31, 1931, $217,957,000.

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Dry Goods Men Debate the Electrical Market

Further discussion as to how retail stores might best develop the electrical market (ELECTRICAL WORLD, January 21, page 82) was offered at the electric appliance merchandising division of the National Retail Dry Goods Association convention in New York last week. General recognition of the large market possibilities for domestic electric appliances was evident, especially after Kenneth Dameron, executive secretary of the Electrical Merchandising Joint Committee, presented his paper, but the question arose several times, "How can the volume of business possibly be conducted at a profit in view of the specialized selling, testing for quality, servicing, etc., which require a technique and organization quite different from anything department stores now have."

Establishing a specialized selling organization and supervision of an electric merchandise manager, distinct from house furnishings department, was cited as one way. Discussion of problems with the local utility and manufacturers was another. Servicing can be handled by contractors, or in their absence by utilities, at a nominal expense, although department stores might well establish an electrical servicing department as the contact with customers opens the way

to wider markets, declared M. E. Skinner, of Niagara Hudson, which has relinquished merchandising to other distribution channels. Testing for quality was discussed extensively by Katherine Fisher, director Good Housekeeping Institute.

Should there be bargain sales?

D. F. Kelly, president of the Fair, Chicago, referred to plans which the joint committee has studied that provide for distribution by other than utilities, with the utility co-operating with and co-ordinating retail selling and stimulating uses. Herman Price, Sears Roebuck, pointed out that shifting sources of supply discourage and prevent manufacturers making appliance improvements which are possible. Who can say that we have the last word in appliances now? They may also become obsolete and replacement is necessary. Department stores have failed to help manufacturers, he declared, by just filling orders instead of promoting sales. Occasionally special-price models are necessary, but manufacturers will not provide them. Selling should be organized on profitable volume selling at small make-up, he declared.

Some things a salesman should know were cited by C. M. Ripley, General Electric Company; for example, cost of operating appliances, what a kilowatt-hour will do, significance of promotion rates, etc. A complete electric kitchen has more lure to the housewife than any single appliance, and if she can afford it all at once, she should be shown how she can acquire it on progressive basis. He reported that he uses 40 domestic appliances for 34 cents per day.

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General Electric Orders Down 52 Per Cent in 1932

Orders received by the General Electric Company during the year 1932 amounted to $121,725,772, compared with $252,021,496 for 1931, a decrease of 52 per cent. Orders for the quarter ended December 31 amounted to $27,-351,658, compared with $25,665,402 for the third quarter of 1932, and with $49,321,480 for the last quarter of 1931, a decrease from last year of 45 per cent. Sales billed and earnings for the year 1932 are not yet available; a complete annual report will be issued in March.

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New York Metal Prices

	Jan. 17, 1933 Cents per Pound	Jan. 24, 1933 Cents per Pound
Copper, electrolytic	5.00	5.00
Lead, Am. & S. R. price	3.00	3.00
Antimony	5.70	5.80
Nickel ingot	35.00	35.00
Zinc, spot	3.75	3.35
Tin, Straits	22.40	22.80
Aluminum, 99 per cent.	23.30	23.30

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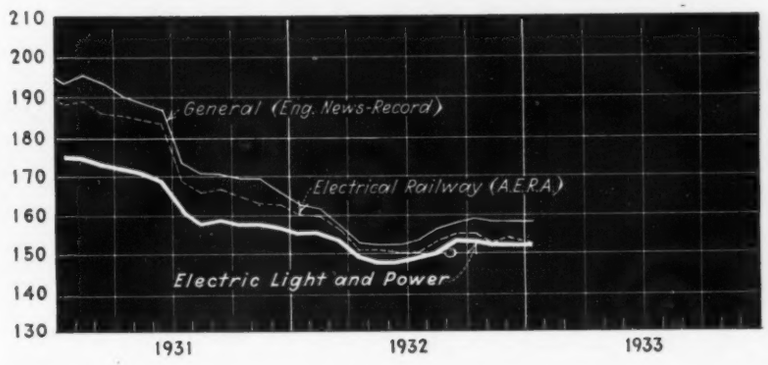
Construction Costs Steady



January construction costs for electric light and power systems remained at the same level as in November and December. Compared with the beginning of 1932 they are now down only 2 per cent, the net result of the decline which continued until May and of the subsequent moderate rise. Changes in two other construction index numbers, shown for comparison in the table, were similar to those for electric light and power.

Because of revisions in this index the figures here given are not comparable with those heretofore published, with the exception of last December. The revised series appeared in the ELECTRICAL WORLD of January 21, 1933, on page 105.

Construction Cost Indexes: Electric Light and Power, Electric Railway and General

Base: 1913 = 100

	Electric Light and Power*	Electric Railway*	General—*Engineering News-Record*
January, 1933	152	152	158.4
December, 1932	152	153	158.5
November, 1932	152	152	158.2
October, 1932	153	154	159.2
September, 1932	153	155	158.0
August, 1932	150	153	156.8
July, 1932	149	150	153.4
January, 1932	155	161	162.5
Last 5 yrs. high	185	206	210.4
Month	Jan., '30	Nov., '28	Feb., '29
Last 5 yrs. low	148	150	152.2
Month	May, '32	June, '32	June ', 32

*Computed by Albert S. Richey.

Major New Construction This Week

Laclede Power & Light Company, St. Louis, Mo., plans installation of transformers, switchgear, feeder and distribution lines, etc., in new substation. Cost over $300,000.

Appropriation of $1,462,925 secured by Board of Transportation, New York, N. Y., for new subway lines during next six months, of which $500,000 will be used for purchase of electrical and mechanical equipment and spare parts.

Machine drives, motors, electric hoists, conveyors, etc., will be required for plant of Best Brewing Company, Chicago, Ill. Cost over $300,000.

Plans authorized by Great Bend, Kan., for city-owned electric plant. Cost over $200,000.

Motors, transformer equipment, conveyors, etc., will be installed at plant of Van Camp Sea Food Company, Los Angeles, Calif. Cost about $100,000, including buildings and equipment.

Oklahoma Gas & Electric Company is arranging program for extensions and improvements in transmission and distribution lines during 1933, including rebuilding and increased substation facilities. Cost estimated over $100,000.

15-Year-Old Pine Poles Reset for New Line

Remarkable demonstration of the long life and sustained strength of pressure-treated pine poles has been made in the line construction of the United Power & Light Corporation near Abilene Kan. Poles with fifteen years of service behind them have been reset by this utility for a new line in the full expectation of many years of good sustained service yet to come.

In 1917, a 6-mile line averaging 19 or 20 pressure creosoted pine poles per mile was constructed. The poles averaged 4 to 5 in. in top diameter, and their standard length was 30 ft. It was found necessary recently to rebuild this transmission line with larger poles because of an increase in the load which the line would have to carry. Of the treated pine poles thus removed two or three were culled out as unfit for future service because of top defects. The remaining 113 poles have since been placed in other lines with poles of similar size, with every anticipation of highly satisfactory results.

One line extending north from the transmission line to Sand Springs was built almost entirely with these poles, 76 being used there. Treating plant records indicate these poles to have been pressure treated with creosote by an empty-cell process with a final retention of 8 lb. of preservative per cubic foot of wood.

Scottsbluff Plant Again Discussed

After turning down at a special election a proposal to institute proceedings to condemn on behalf of the city the properties of the Western Public Service Company (ELECTRICAL WORLD, October 8, page 488) voters of Scottsbluff, Neb., will vote at the regular city election, April 4, on granting Congressman Terry Carpenter a power franchise. The Council ordered this action after killing an ordinance drastically reducing the power company's rates.

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Virginia Electric Wins Case

Maintaining that the state cannot include the business of selling electrical appliances in making up its tax assessment against utilities furnishing light and power, the Virginia State Supreme Court of Appeals upheld the Virginia Electric & Power Company in its case versus the State of Virginia. The case involved taxes which the Commonwealth claimed were due it from the power company, but which the Appellate Court held were wrongfully assessed.

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Central Hudson Rates Reduced

First step in a general rate reduction program by the New York Public Service Commission is involved in the cut for portions of eight up-state counties. The territory is served by the Central Hudson Gas & Electric Company. The reduction is approximately $232,000 a year.

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Air Conditioning to Save Documents

Air conditioning is to play a prominent rôle in the preservation of valuable government records and historical documents to be housed in the National Archives Building now under construction at Washington, D. C. Complete refrigeration and air conditioning of this monumental structure will require seven complete air-conditioning systems, all under automatic control, which will supply 315,000 cu.ft. of conditioned air every minute to the various sections of the building.

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Missouri Commission Row Looms

Attacks upon the Missouri Public Service Commission, as in every year since it was formed except 1931, and enactment of a law restricting its powers are likely in the coming session of the Legislature. The Missouri commission, patterned after that of New York, regulates the rates of all public utilities, has authority to raise or lower the rates and has power to hear complaints as to service. It also grants permission to utilities to issue stock issues. Democratic leaders are said to desire the opportunity to name the membership of the commission, which has been bipartisan since its inception. Under the direction of Chairman Stahl, rulings made by the Missouri commission in the last four years have attracted wide attention. Virtually every important decision of the commission has been upheld by higher courts.

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Utility Files Suit Against Minnesota

Complaining that property taken through condemnation proceedings will destroy its power developments on the St. Louis River, the Minnesota Power & Light Company has filed in the District Court an appeal against the state of Minnesota in which it demands $900,000 damages. The notice of appeal involves condemnation proceedings instituted by the state for the relocation of highway No. 8.

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South Carolina Truce Effected

Duke Power Company and its subsidiary, the Southern Public Utilities Company, have agreed to a compromise with the South Carolina Railroad Commission on reduced rates, the commission has announced. The new rates are made effective as of November 1, 1932, refunds being made to those customers entitled to them. Meanwhile, the commission has ordered the companies to show cause why their rates "should not be investigated and declared unreasonable and excessive, and why the said rates should not be revised and substantially reduced." A hearing is set for 30 days after the serving of the order. Under the terms of the compromise agreement no bill shall be rendered to any customer at a rate higher than the schedules previously in effect. The commission's chief objection to the companies' prior offer was that in some instances rates would be raised (ELECTRICAL WORLD, December 31, page 866).

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Broad River Rate Cut Ordered

South Carolina's Railroad Commission has ordered the Broad River Power Company to reduce its rates so as to effect an annual saving to consumers of $170,000. The commission's order followed a long series of hearings, beginning September 20. Officials of the company, when informed of the order, announced their intention of fighting it to "the last ditch." "Fair valuation" of the company's physical properties is seen as the key to the power company's dissatisfaction with the commission's decision. The commission fixed $12,500,000 as a "fair valuation" for rate-making purposes, as against the company's own figure of more than $26,000,000.

To Resume Colorado River Project?

Application for a $4,500,000 loan to cover the costs of completing the dam on the Colorado River near Austin, Tex., has been filed with the Reconstruction Finance Corporation by the Colorado River Water Users' Association. The project, inaugurated by a subsidiary of former Insull interests, was halted about a year ago by financing difficulties, after $3,500,000 had been expended on its construction. The association proposed to offer its own bonds to the R.F.C. and to provide for repayment out of proceeds from sale of water under irrigation rights.

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District Plant Urged for Washington

Recommendation that Washington, D. C., establish a district-owned and operated power plant to fill the public and private requirements of that area has been made in a report of engineers who have just completed a congressionally authorized survey. Representative Cannon, chairman of the House appropriation subcommittee on the District of Columbia, stated that approximately $4,000,000 annually could be saved taxpayers by the erection of the plant.

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What Hydraulic Laboratories?

Listing of every laboratory performing hydraulic research is sought by Chairman O. C. Merrill of the World Power Conference, American Committee. An ultimate exchange of international research data is envisioned.

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Ohio Confirms Schaber Appointment

Governor George White's appointment of Charles G. Schaber of Bucyrus as a member of the Ohio Public Utilities Commission has been confirmed by the state Senate with a 28 to 3 vote after a bitter discussion. Opponents of the appointment of Mr. Schaber sought to show at hearings which were held before the state Senate rules committee that the selection was dictated or suggested by public utility interest. In a special message to the Senate Governor White had requested the investigation of the charges made following the storm of protest that greeted the announcement of the appointment.

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New Lamp Broadcasts on Light Beam

Music on a beam of "cold light" linked an improvised radio studio in the tower of the Chrysler Building with the sixteenth floor of the Columbia Broadcasting System's building, a distance of half a mile, last week. The lamp, the invention of Elman B. Myers, was described and illustrated in the October 22 issue of the ELECTRICAL WORLD, page 553.

Another Pumped Storage Plant for the Rhineland

To handle peak loads and at the same time utilize the excess energy available at night the Société de l'Energie Electrique du Rhin, whose Kembs station opened last year (ELECTRICAL WORLD, July 16, page 73, and October 22, page 545) is constructing a pumped storage plant to be connected by transmission lines with the Kembs project.

Two natural lakes about five-eighths of a mile apart with a mean difference in level of 357 ft. are being used. Water will flow from Lac Blanc by way of a tunnel and pipeline through turbines into Lac Noir and after being used will be pumped back into Lac Blanc. The maximum variation in the water level of both Lac Blanc and Lac Noir will be approximately 60 ft.

Approximately 242,000,000 to 308,000,000 gal. will be exchanged daily. The maximum capacity of the turbines can be discharged in about four hours. The pumping period lasts about twice that time. The power house will eventually contain four units, each consisting of a pump, a turbine and a generator mounted vertically above each other in the order mentioned. The generators are each rated at 25,000 kva., 12,000 volts. Francis-type turbines of 24,000 hp. at a minimum net head of 278 ft. are used. At high head the output can be adjusted to correspond to the capacity of the generators, each turbine being able to develop a maximum of about 40,000 hp. Each centrifugal pump offers a mean delivery of 2,860 gal. per second and requires up to 27,000 hp.

Unlike other storage plants (ELECTRICAL WORLD, July 2, 1932, page 9) the pumps are not uncoupled while the turbine is in operation, but are always connected. The pump or turbine volute is emptied of water by compressed air and the idling machine run light. It is expected that the station will be put in operation provisionally with two sets in the autumn of 1933.

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Cable Corrosion Reduced by External Grease Film

Cases of cable sheath corrosion have occurred for years, the cause generally being reported as "unknown," while application of the usual electrolysis preventives has aggravated the trouble rather than reduced it. At a recent meeting of engineers it was indicated that the cause of such troubles may have been located. The preventive found is applicable either when installing or reinstalling cable. The installed-cable problem has not been satisfactorily solved yet, although an approach to this phase of the problem is visualized.

The type of corrosion referred to occurs even without current flowing away from or toward the cable and manifests itself in vari-colored patches, or striations on the cable sheath, that gradually replace the lead and eventually lead to breakdown of the insulation. In view of the fact that utilities report that 35 to 40 per cent of cable troubles have their origination in sheath trouble, this discovery of one of the previously "unknown" causes should be helpful in making greater use of investment and reducing maintenance expense of underground lines.

Investigations indicate that cable-sheath corrosion is caused by chemical action between the surface particles of the sheath which set up high-voltage gradients, causing local electrolysis and decomposition of the lead. It appears that oxygen must also be present for the decomposition combinations. Size of granules in the sheath affect the speed of disintegration, according to the observations reported upon.

The preventive found to be most successful so far is to apply a copious layer of grease to the cable when installing. The grease must have high tenacity, be resistant to alkalies and be inexpensive. Other properties are necessary, but it is surprising that ordinary black axle grease has been found quite effective. A film of the protective covering must be retained under installation and operating conditions. Protection of installed cable could be afforded, it has been suggested, by flooding the ducts with grease, but this is considered too expensive. Consideration is also being given to "thiokol" and similar protective films over the lead.

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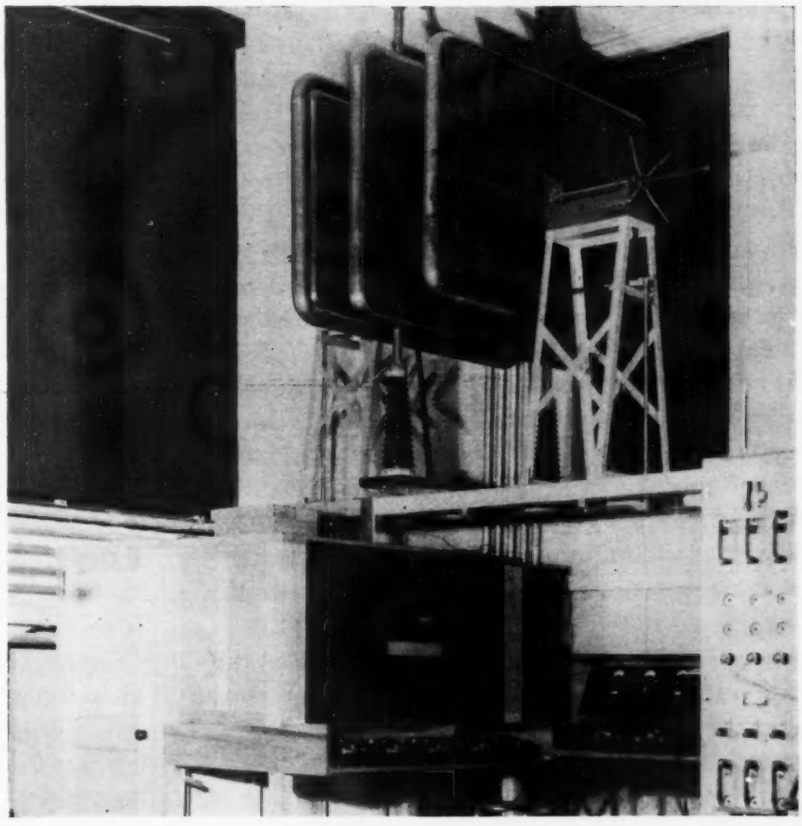
New High-Voltage Bridge Measures Low Power Factors



Designed to measure all dielectrics of very low power factors down to 0.1 per cent and below, and through a range up to about 95 per cent power factor and up to 200 kv., the limit of the air condenser illustrated, a high-voltage bridge of increased range, larger operating flexibility and possessing noteworthy safety features has recently been developed by the Harvard Engineering School. Three high-pass filters are provided to remove harmonics in the detector circuit, and to avoid inductive effects from charging the storage battery used with the bridge galvanometer and three-stage amplifier the battery is mounted on a portable truck so that a spare set of charged cells will always be available. The entire manipulation of the bridge is effected through 12-in. bakelite rods passing through a solidly grounded metal shield. Control of high-voltage equipment is by the portable console shown at the right of the bridge.

EDITORIALS

L.W.W.MORROW
Editor

Ultimate Consumer Sales—The Answer

COLLECTIVE action directed toward ultimate consumers can bring business recovery to the electrical industry. We pointed to these markets in the January 7 issue of ELECTRICAL WORLD and showed their magnitude. Last week at the N.E.M.A. meeting H. P. Liversidge cited two instances of how to sell the markets through collective action. Last year, despite a national decrease of 37 per cent in refrigerator sales, the electrical industry in the Philadelphia territory increased the dollar value of refrigerator sales 1 per cent and the number of units sold by 7.5 per cent. The second instance cited was in the building industry, in which the first conference found everything negative and a unanimous opinion of bankers and builders that the territory was overbuilt. After a detailed canvass and a planned sales program for January a $15,000,000 business was budgeted and in the first twelve days of the campaign $13,000,000 of business was sold, with expectations of closing $50,000,000 by the end of the month. The answer to poor business was intelligently directed sales work in the marketplace, with *all* units working together under a plan.

NO OUTSIDE aid can be counted upon to bring prosperity to the electrical industry. It must reorganize to make profits on present business and it must direct its activities toward getting more business by unlocking the dollars of ultimate consumers. In 1932 some 1,000 electrical manufacturers recorded deficits on $800,000,000 of production; in 1914 the same number of manufacturers made money on $300,000,000 of production. This indicates that penny pinching and skeletonizing organizations are not effective policies and shows that a completely revamped organization for the present volume of business must be used to reach a profit scale of activity. The utilities also, because of a drop in income of some 7.5 per cent on operating properties, that reflects itself multifold on capital issues of top holding companies, are inert in the marketplace and will not spend money on promotional efforts. This psychology of both the manufacturers and utilities is the same as that of the bankers who now think they are practicing intelligent banking by locking depositors' money in their vaults.

EVIDENCE exists that the markets can be sold. Balance sheets of industry enterprises show no profit, and the conclusion is inescapable that organizations are still maintained that were formed to operate profitably on the 1929 business volume. A policy of defense, inertia or stress on minor economies prevails, with a minimum of optimism or aggressive sales effort, and this leads nowhere. We know that business recovery will not come of itself, or through the influence of political agencies. There is all to gain and nothing to lose, therefore, in organizing to make money on the present volume of business and to use every effort to sell the consumer markets. This can be done if action is taken to conform to facts and if all elements of the industry unite for collective and vigorous sales efforts directed toward the ultimate consumers in each local market. Why not start now in each community?

Costs in distribution should be available

AN INTERESTING meeting to discuss the costs involved in electric distribution was held in New York. While it was impossible to assemble a great amount of actual data, it was possible to discuss the topic intelligently and to make suggestions for further studies. Knowledge of the cost of distribution is of great value to engineers in order to improve system design, or to make economies in system operations. It is also valuable from the point of view of regulatory authorities as part of the data needed to decide rate cases and valuation disputes more quickly and more equitably. It is a valuable aid to utilities in making extensions of service and in deciding upon rates for new business.

Costs of distribution vary widely and it is unfair to use costs in high load density or high use areas for comparisons with national average costs or rates. It is also easy to place too much stress on the cost of service as the basis of class rates. Nor should cost reductions be stressed too greatly in preference to study and work to intensify the use of electric service. The way to get low rates and low costs is to sell more service.

Commissions also must act according to law and legal precedents in making rate decisions and cost of service is only one of many variable items that should be used in determining rates. With so many uses for costs it is very evident that these analyses can be overdone and can be used to make false deductions. Put to their best use, however, they serve as a guide to management and to regulatory authorities and should be made available on individual properties. Further action on the topic might well take the form of a clearer and more detailed classification of the capital items in the uniform classification of accounts and, in addition, it would be well for the engineers as a group to study these costs as an engineering assembly of distribution equipment. There is no valid reason to avoid all possible factual knowledge of the electrical business in relation to any of its activities, and distribution costs are especially concerned with the engineering assembly and operation of a property.

Rectifier prospects are written up by pencil

DISCOVERY of a new arc principle bids fair not only to raise havoc with preconceived notions of rectifier dimensions but also to set new standards punctilious in performance. Joseph Slepian and L R. Ludwig told at the A.I.E.E. convention of a simple but superlative control adjunct of the mercury rectifier which lends to the multiphase arc all the regularity and precision of mechanically timed automotive ignition. Grids are supplanted by it and down go anode-to-cathode distances and arc-space volume until the rectifier may at an early date fulfill the prediction that it would some day be only a fraction as big as the transformer which serves it. Along with this comes the certainty of ignition every cycle at any desired point on the voltage wave; also the phase segregation it entails precludes the spurious behavior of a negative anode of another phase.

None of these prospects was essayed in the paper which followed the conventional presentation of the academician who provides the technical tool and lets others worry or gloat over the consequences. The moderate voltage gradient maintained over the surface of a pencil or cylinder of high-resistance material projecting into the mercury bath is all that is necessary to attain continuous and absolute ignition of the arc at the interface between pencil and mercury. With the arc condition assured at the mercury cathode there is certainty of its establishment at the anode. Energy requirements are mere watts for control of several hundred kilowatts.

Readable into the picture are many other possibilities built on taking out of the mercury arc those elements of doubt and uncertainty which have in the past called for generous proportioning and devious control. Shot welding at high intensity for a few cycles in every few seconds is one development that should ensue. Abrupt interruption of arcs in switching can undoubtedly be perfected by shunting a grid-controlled tube with such ignition around the separating switch contacts. The scheme should find a field in high-speed excitation by circumventing the inductive obstacle in the exciter. Voltage control in certain applications should in turn also yield to the new phenomenon.

More Diversity in Home Uses Than Code Recognizes

By W. F. WALSH

System Meter Supervisor Central Hudson Gas & Electric Corporation, Poughkeepsie, N. Y.

THE diversity factors of various loads and circuits are of fundamental importance to both consumer and electric company. Suitable "time displacement" of loads will permit the greatest possible use of a given investment and therefore the lowest cost of service. In other words, by fostering and utilizing the maximum possible diversity a smaller investment can be made to serve a greater connected load.

This principle has spread from the early combination of lighting and power feeders on distribution systems to the gigantic interconnected superpower transmission systems of today and has contributed much to the phenomenal expansion and continually lowering cost of electric service. Institution of demand rates aimed at diversity improvement has been partly responsible for the substitution of individual for group drives in industry, with the resulting supply of increasing connected loads at little or no increase in total demand.

Only in recent years, however, have promotional, diversity-recognizing rates materially changed the situation with regard to urban and rural residences. Here a rapid increase in the use of electric appliances of various and sundry nature has resulted. Concurrently with this growth has come the recognition that these devices cannot all be used simultaneously, that some demand or diversity factor must inherently exist and, further, that the greater the number of appliances available or connected the greater will be the diversity resulting from their normal use.

Purpose of Study, Methods and Data—Believing that much the same conditions obtained in fully electrified homes as in industrial plants, a study of demand factors has been undertaken. This study has centered principally around those homes which were equipped with electric ranges, water heaters, ironers, refrigerators, water pumps and numerous other smaller appliances usually found in full-use homes.

The study was started with a review of all customers having a "complete" electrical home and typical ones were selected for the installation of graphic wattmeters and demand meters. Records were obtained for approximately eight months, the graphic wattmeter charts being

Code Requirements for Calculating Demands of Single-Family Residences

Section 613

A — One watt per square foot, plus 1,000 watts for appliances.

B — For area of 2,000 or less square feet, demand 100 per cent; for all excess over 2,000 sq.ft., 60 per cent.

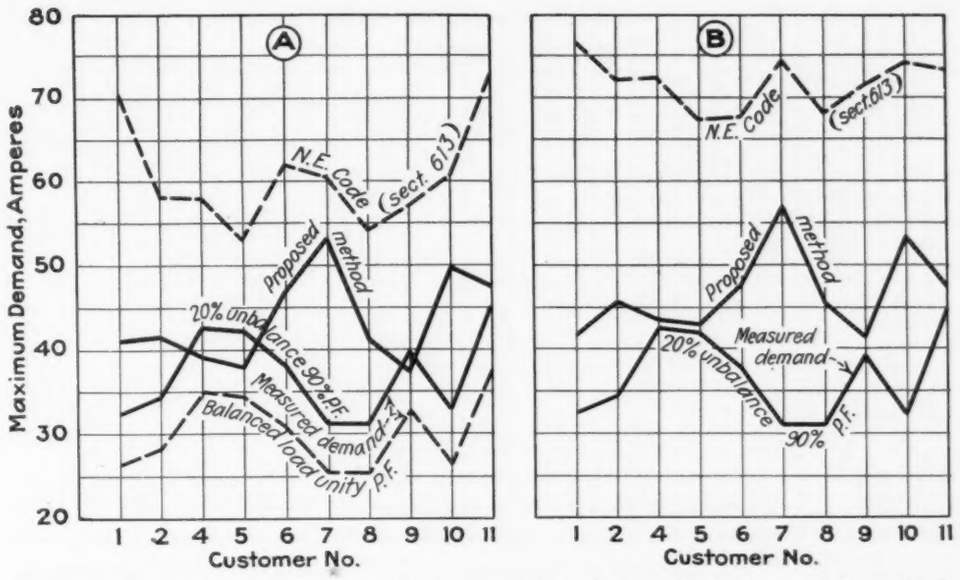
C — Appliances and ranges using more than 1,650 watts each:

Number	Demand Per Cent
1	100
2	100
3	95
4	90

Table I—Characteristics of Residential Insta

Estimated lighting — 1,500 watts connected. Customer No. 3 record discontinued after one week and superseded by customer N
col. 39 = (col. 29 × 10

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Customer No.	Demand Type	House Area (Sq.Ft.)	No. of Outlets	Range Rating (Kw.)	Water Heater Rating (Kw.)	Ironer Rating (Kw.)	Refrigerator	Water Pump	Radio	Vacuum Cleaner	Toaster	Hand Iron	Griddle	Corn Popper	Percolator	Curling Iron	Milk Cooler	Milking Machine	Water Heater in Dairy (1 Kw.)	Ironer	Washing Machine	Waffle Iron	Heating Pad	Sewing Machine	Oil Burner — 1/6 hp.	Dish Washer	Space Heater
1	Gra.	4,200	15	9.56	1.0	1.8	●	●	●	●	●	●	..	..	..	..	●	●	●	●	●	●	..	..	..	..	..
2	Gra.	2,304	32	9.6	1.3	...	●	..	●	●	●	●	..	●	●	..	..	..	..	..	●	●	●	..	..	..	..
3	Gra.	2,400	..	7.5	1	...	●	●	●	●	●	●	..	..	●	●	..	..	..	●	●	●	..	..	..	..	..
4	Ind.	2,368	22	9.6	1.5	...	●	●	●	..	●	●	..	..	●	..	..	..	..	..	..	..	..	●	..	..	..
5	Ind.	2,100	33	8.56	1.3	...	●	●	●	●	●	●	..	..	●	●	..	..	..	..	..	●	●	..	●	..	..
6	Ind.	1,200	39	9.56	1.0	1.8	●	●	..	●	●	●	●	..	●	..	..	..	..	●	●	●	●	..	..	..	..
7	Ind.	3,200	79	9.6	1.0	...	●	..	●	●	●	●	..	●	●	●	..	..	..	..	..	●	..	..	●	..	..
8	Ind.	1,232	32	9.5	1.0	...	..	●	●	..	●	●	..	..	●	..	..	..	..	..	●	..	..	..	..	..	..
9	Ind.	2,168	15	9.56	1.0	...	●	●	●	●	●	●	●	●	●	●	..	..	..	..	..	..	..	..	..	..	..
10	Ind.	2,520	60	10	1.5	...	●	..	●	●	●	●	..	..	●	..	..	..	..	..	..	●	●	●	..	..	..
11	Gra.	2,058	34	10	2	1.8	●	●	●	●	●	●	..	..	●	..	..	●	..	●	●	●	..	..	..	●	●



In both cases the curve labeled "20 per cent unbalance" is based on measured kw. at 220 volts translated into amperes assuming 90 per cent power factor and 20 per cent unbalance, current being indicated for the high-current side of three-wire service. In graph A the maximum demands apply to actual customers for equipment now in their possession. In graph B the data from graph A are modified on the basis that 2,000-watt water heaters and 1,800-watt ironers are used by all customers.

Customers 1 and 6 have 9.56-kw. range, 1-kw. water heater and 1.8-kw. ironer. Customer 11 has 10-kw. range, 2-kw. water heater and 1.8-kw. ironer.

Data plotted from Table I.

Figs. 1 a and b—Comparison of measured maximum demands with those calculated by code and proposed method

removed and scanned for the highest demand on each section of chart regardless of its time duration, and the demand meters being reset to zero each month so that monthly demands would be available for analysis.

All information which was considered essential for a complete study was obtained, including house area, number of outlets, range capacity, water heater capacity, record of all appliances, together with the individual maximum demands and their time duration.

Interpretation of Data—A very brief review of the maximum measured demands compared with the connected loads reveals that a considerable diversity does exist, the maximum recorded demand being 8.2 kw. on a connected load of at least 15 kw. As the range is the largest rated appliance its use probably has the greatest effect upon the actual demand. A study of the magnitude of this factor and possible methods for its proper evaluation is summarized in Table V, which shows definitely that the highest demand factor which should be applied to a single range is 80 per cent.

Comparing these results with those obtained by applying Sec. 613 of the National Electrical Code for demand determination indicates (Table I) that the maximum percentage of actual to Code demand is 65.4 and the lowest 34.4 From these figures it seems obvious that the Code requirements which allow no diversity factor for either one or two appliances of more than 1,650-watt rating each are unduly stringent and that a more accurate and yet adequate method should be considered.

Proposed Revision of Demand Calculations—Extensive study of this problem has resulted in a proposed method as follows:

I. Allow ½ amp. for each outlet and a minimum of 5 amp. per circuit.

...s Having Electric Ranges and Water Heaters

...a in column 29 from Tables II and III; col. 32 = (col. 29 × 1000) ÷ col. 31; col. 33 based on 115 volts; col. 37 = col. 31 ÷ 220; ...col. 43 (from Table IV).

31	32	33	34	35	36	37	38	39	40	41	42	43	44
		Based on Proposed Method					Ampere Demand						
		Total Demands											
Watt Demand Based on Art. 6, Sec. 613 of Code	Actual Demand in Per Cent of Watt Demand (Sec. 613)	Outlets (Watts)	Large Appliance Demand (Watts)	Watts	Amperes at 230 Volts	Amperes Demand at 220 Volts if Each Customer Used 1,800-Volt Ironer and 2-Kw. Water Heater	Based on Sec. 613—at 220 Volts	Based on Measured Demand at Unity P.F.—Balanced Load at 220 Volts	Based on Measured Demand at 20 Per Cent Current Unbalance and 90 Per Cent Power Factor; High Amp. Side of 3-Wire Load	Based on Sec. 613 if Water Heaters Were 2 Kw.	Based on Sec. 613 if Customers had 1,800-Watt Ironers and 2-Kw. Water Heaters	Average Monthly Kw.-Hr.	Customer No.
15,680	37.0	863	8,520	9,383	40.8	41.5	71	26.4	32.3	....	77.3	**934**	1
12,782	48.5	1,840	7,680	9,520	41.4	45.9	58	28.2	34.5	67.1	72.2	**265**	2
14,540	34.4	.....	.....	.....	....	....	66.2	22.7	27.7	....	.....	...	3
12,820	60.0	1,265	7,680	8,945	38.9	43.3	58	35.0	42.9	67.1	72.5	**379**	4
11,620	65.4	1,898	6,848	8,746	38.0	43.1	53	34.5	42.2	62.1	67.2	**675**	5
13,560	50.1	2,242	8,520	10,762	46.9	47.7	62	30.9	37.7	....	67.6	**654**	6
13,320	42.1	4,545	7,680	12,225	53.2	57.6	60.6	25.4	31.1	69.7	74.7	**633**	7
11,832	47.3	1,840	7,680	9,520	41.4	45.9	54	25.4	31.1	63.1	68.0	**268**	8
12,660	56.9	863	7,648	8,511	37.0	41.5	57	32.7	39.9	66.1	71.8	**566**	9
13,312	43.5	3,450	8,000	11,450	49.8	54.0	60.5	26.4	32.3	69.6	74.6	**356**	10
16,136	48.7	1,955	8,975	10,930	47.6	47.6	73.4	37.3	45.6	....	73.4	**746**	11

Table II—Graphic Meter Demands of Three Customers

These demands are the maximum values recorded for various periods of chart records. Customer's maximum demands are in boldface; also p.m. intervals to distinguish from a.m.

Customer No. 1				Customer No. 2				Customer No. 11			
Kw.	Date	Interval	Minutes	Kw.	Date	Interval	Minutes	Kw.	Date	Interval	Minutes
4.1	2/16/31	**4:27-4:32**	5	5.9	4/ 5/31	**1:50-1:52**	2	**8.2**	7/27/31	**3:05-3:15**	10
5.0	4/18/31	**4:27-4:37**	10	4.3	5/23/31	**6:44-6:46**	2	7.2	8/ 6/31	**12:53-12:58**	5
...	.....	.....	..	3.4	6/29/31	**6:48-6:58**	10	6.3	8/27/31	10:50, 11:08	18
...	.....	.....	..	**6.2**	6/ 7/31	**1:25-1:37**	12	6.0	9/ 2/31	8:32–8:34	2
...	.....	.....	..	3.9	7/22/31	**12:05-12:17**	12	6.6	9/15/31	9:20–9:22	2
5.8	7/ 8/31	**6:23-6:28**	5	3.3	8/ 6/31	**12:17-12:22**	5	**8.0**	9/24/31	**2:25-2:35**	5
5.5	7/20/31	**5:11-5:21**	10	3.3	8/21/31	**6:10-6:15**	5	6.4	9/27/31	**1:55-1:58**	3
5.1	7/31/31	**7:57-8:00**	3	4.1	8/28/31	**5:20-5:25**	5	6.2	10/10/31	**1:23-1:27**	4
5.0	9/11/31	**6:10-6:25**	15	4.6	9/ 4/31	**7:10-7:13**	3	5.8	10/18/31	**5:50-6:05**	15
4.6	9/23/31	**2:35-2:37**	2	4.4	9/14/31	**4:20-4:32**	12	5.7	10/27/31	**2:10-2:18**	8
3.8	9/28/31	7:25–7:30	5	4.4	10/ 8/31	**1:02-1:05**	3	7.2	11/ 3/31	**5:07-5:08**	1
4.3	10/ 5/31	**5:32-5:40**	8	5.8	10/24/31	9:00–9:05	5	...	.....	.....	..
4.3	10/19/31	**3:47-3:58**	11	5.8	11/ 2/31	**4:21-4:28**	7	...	.....	.....	..
4.3	10/23/31	5:12–5:14	2	...	.....	.....	..	...	.....	.....	..
4.3	11/ 1/31	4:53–4:59	6	...	.....	.....	..	...	.....	.....	..

Table III—Demands of Seven Customers Based on Block-Interval Demand Meters—Fifteen-Minute Interval

Demands are the maximum values for the periods between dates, the demand indicators being reset after each reading.

Customer No. 4 Installed 2/25/31		Customer No. 5 Installed 2/19/31		Customer No. 6 Installed 2/19/31		Customer No. 7 Installed 2/13/31		Customer No. 8 Installed 2/27/31		Customer No. 9 Installed 2/11/31		Customer No. 10 Installed 2/11/31	
Date Read	Kw. Demand	Date Read	Kw Demand	Date Read	Kw. Demand	Date Read	Kw. Demand	Date Read	Kw. Demand	Date Read	Kw Demand	Date Read	Kw Demand
3/24/31	6.4	3/25/31	6.0	3/25/31	5.7	3/25/31	**5.6**	3/25/31	**5.6**	3/19/31	4.6	.....	...
5/ 5/31	6.1	5/ 6/31	6.8	5/ 6/31	6.0	5/ 6/31	4.0	5/ 6/31	4.1	4/23/31	5.2	4/23/31	4.0
6/19/31	7.6	6/18/31	**7.6**	6/18/31	6.1	6/18/31	5.2	6/18/31	4.8	5/18/31	5.8	5/18/31	3.9
7/22/31	7.2	7/23/31	5.8	7/22/31	**6.8**	7/17/31	5.4	7/17/31	5.2	7/29/31	6.1	7/29/31	**5.8**
9/11/31	**7.7**	9/11/31	6.0	9/11/31	6.5	9/12/31	5.3	9/12/31	5.2	9/18/31	**7.2**	9/18/31	4.2
10/14/31	7.3	10/ 7/31	5.8	10/14/31	5.9	10/ 7/31	5.4	10/ 7/31	4.2	10/21/31	6.6	10/21/31	4.1
11/ 9/31	**7.7**	11/ 9/31	**6.2**	11/11/31	5.8	11/11/31	5.2	11/11/31	5.2	11/12/31	**7.2**	11/12/31	4.2

II. Make no additional allowance for appliances under 1,650 watts each.

III. For all devices rated at more than 1,650 watts add to (I) their total rating modified as follows:

No. of Devices Over 1,650 Watts	Proposed Multiplier (Demand Factor)	Present N.E.C. Multiplier (Demand Factor)	No. of Devices Over 1,650 Watts	Proposed Multiplier (Demand Factor)	Present N.E.C. Multiplier (Demand Factor)
1	80	100	14	25	42
2	75	100	15	25	40
3	65	95			
4	50	90	16	25	39
5	40	85	17	25	38
			18	25	37
6	35	80	19	25	36
7	32	75	20	25	35
8	30	65			
9	29	55	21	25	34
10	28	52	22	25	33
			23	25	32
11	27	48	24	25	31
12	26	46	25	25	30
13	25	44	Over 25	25	30

Table IV—Monthly and Total Consumptions of Ten Customers

Each customer's maximum, minimum and average monthly consumption is shown in bold face

Customer No.	February	March	April	May	June	July	August	September	October	Total	Average Monthly Kw.-Hr.
1	904	816	962	904	954	**1,034**	960	938	934	8,406	**934**
2	**310**	266	308	270	258	**218**	242	284	228	2,384	**265**
4	442	**276**	344	494	**606**	314	318	292	326	3,412	**379**
5	630	**554**	648	670	672	686	668	**850**	694	6,072	**675**
6	592	**688**	592	668	**572**	710	614	670	**780**	5,866	**654**
7	572	**560**	656	658	**696**	682	608	618	650	5,700	**633**
8	316	**286**	**104**	190	256	288	**338**	308	324	2,410	**268**
9	458	**426**	510	642	602	628	**648**	624	554	5,092	**566**
10	**320**	**334**	**354**	**416**	**380**	**336**	**384**	**322**	**356**	3,202	**356**
11	...	...	...	...	794	**819**	**686**	745	687	3,731	**746**

Data have not been obtained to substantiate the proposed demand factors for four or more appliances above 1,650 watts each; however, it is believed that the proposed demand factors represent the actual values more accurately than the present code requirements and, therefore, are offered for consideration.

It will be noted that the Code method involves the application of an area basis for partial determination of the demand factor and a set value of 1,000 watts for appliances under 1,650-watt rating. Important also is the fact that no diversity of demand is allowed for one or two appliances above 1,650-watt rating each and that a factor of only 95 per cent is applied when three appliances above 1,650 watts are part of the connected load.

The proposed method involves the application of a set value of ½ amp. per outlet for determination of the lighting and small appliance demand instead of using the area basis. It is felt that the ampere demand is more easily and reasonably determined from an outlet basis than from an area basis as it is quite possible to have as many outlets in a bungalow type of house as it is in a house having two floors occupied by one family.

A minimum of ten outlets or 5 amp. is to be calculated for each branch circuit so as to avoid the possible installation of a large number of lightly loaded circuits.

Results Under Proposed Method — Applying this method to the cases studied indicates (Table I and Fig. 1A) much closer agreement with the actual demands than is provided by the Code method. Continuing the study to include an assumed condition of an 1,800-watt ironer and a 2,000-watt water heater on each service, the results presented in Fig. 1B show that the proposed method again results in a closer and fully adequate approximation to the actual demand.

Conclusion—It is believed that the results of this study

Table V—Determination of Demand Factor of Range

It is shown that some demand factor should be applied to a range regardless of other equipment. Even if the entire maximum demand were due to the range alone the highest proportion of the rating of the range is 88.8 per cent (column 4) with an average for all installations of only 69.5 per cent. However, it is unquestionable that at least 10 per cent of the maximum demand is attributable to other appliances such as the water heater, refrigerator, radio and possibly the water pump, and therefore a factor of 90 per cent was applied to the maximum demands and the revised demand shown in column 5.

These values (column 5) are considered very fair for actual demands on the ranges equal in the highest case to 79.8 per cent of the range rating and averaging only 62.5 per cent. It will be noted that quite a few demands are only a little over 50 per cent of the range rating.

Therefore, it is contended that a demand factor of 80 per cent should be applied to the range in all installations when the range is the only applicance above 1,650-watt rating.

Column 4 = column 3 ÷ column 2; column 6 = column 5 ÷ column 2.

1	2	3	4	5	6
Customer No.	Range Rating Kilowatts	Maximum Demand Kilowatts	Per Cent of Range Rating	Assume 90 Per Cent of Demand Due to Range	Per Cent of Range Rating
1	9.56	5.8	60.7	5.22	**54.6**
2	9.6	6.2	64.6	5.58	**58.1**
3	7.5	5.0	66.7	4.5	**60.0**
4	9.6	7.7	80.2	6.93	**72.2**
5	8.56	7.6	88.8	6.84	**79.8**
6	9.56	6.8	71.1	6.12	**64.1**
7	9.6	5.6	58.3	5.04	**52.5**
8	9.6	5.6	58.3	5.04	**52.5**
9	9.56	7.2	75.3	6.48	**67.8**
10	10	5.8	58.0	5.22	**52.2**
11	10	8.2	8.20	7.38	**73.8**
Average.....			69.5		**62.5**

show conclusively that considerable diversity exists on residential services having electric ranges and water heaters. It is contended that this diversity applies under all normal conditions and that, because of it, consideration should be given to a revision of the present Code method of calculating the demand factor of such installations, such revision to bring the calculated demand more nearly in agreement with the actual.

It is further professed that the method suggested in this report would accomplish this result with material economic savings and without compromising the safety features of electrical installations which are so essential to the protection of life and property.

▼

Figures Were Transposed

By an interchange of figures in the issue of January 7, 1933, page 11, fourth paragraph, the wrong production quantities were associated with the dollar values. The first two sentences should read as follows:

The electric washing machine census for 1931 gives 767,611 machines, valued at $38,236,424, in 1929 and 956,062 machines, valued at $59,930,902, in 1931. Domestic and industrial electric sewing machines aggregated 437,000, valued at $27,625,000 in 1929 and 227,300 valued at $13,125,000 in 1931.

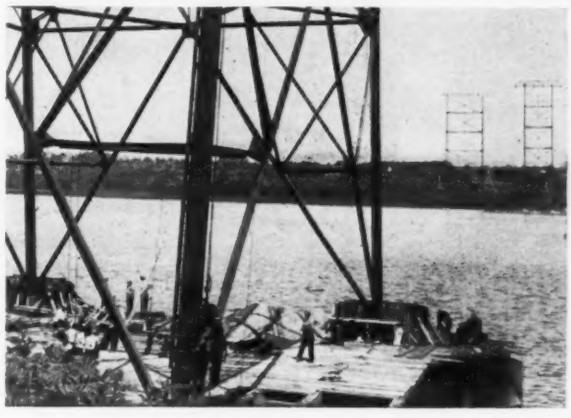
On the lower part of page 44 the number of employees in 1925 should be 239,921 and on page 45, second table, the figure in the first column, motors—fractional hp., should be 33,400.

Two-Circuit Crossing Strung in Two Days

Stringing eight cables in a 2,100-ft. span across the Hudson River in less than two days is the unique record set recently by a crew operating on the Catskill-Poughkeepsie section of the transmission line interconnecting the Niagara Hudson and New York Edison systems. The crossing is located one mile south of the towns of Athens and Hudson.

A 5-ton tractor, with winch and niggerhead, was set up back of each tower and reels placed under the tower on the west bank of the river. The cable was then drawn across the river in the customary manner.

After the cable had been drawn out on the east bank the insulator string was attached and a $\frac{7}{8}$-in. plow steel cable passed from the complete assembly up over the crossarm and down to the tractor. The same procedure was carried out on the west bank as soon as the cable was off the reel. The insulators were raised simultaneously between two tractors and hooked to the towers. Lines were then cast off and the operation repeated on the next cable.



Two tractors raise pre-cut cable on this 2,100-ft. crossing

Towers 267 ft. high weighing 240,000 lb. each carry two 110-kv. circuits and two ground wires. Line conductors 605,000 circ.mil A.C.S.R., spaced 18 ft. apart in horizontal plane. Ground wires ⅜-in. seven-strand copperweld cable, 72 ft. apart and 12 ft. higher than the conductors.

In order to eliminate appreciable delay in the field the A.C.S.R. conductor lengths for this river crossing span had been calculated, the cable cut to correct size and the dead ends applied at the factory, a procedure which has been used for several years on A.C.S.R. installations of this nature. The extremely close agreement between the cable sags and the calculated values made final adjustments a negligible factor.

Often on a job of this type most of the crew is tied up while the dead end is being made. Also, the field assembly of these parts necessitates the use of extra rigging. It is estimated that on spans where it is possible to use factory-attached dead ends the cost of stringing can be reduced by as much as 50 per cent, or more, of the cost of the field make-up.

Moderate Gain in Central-Station Operations

BOTH revenue and energy output of electric light and power companies approached somewhat closer to 1931 figures in November than in any other month since last April. Revenue, on the basis of returns for about 80 per cent of the industry, is estimated at $169,730,000, down 6.9 per cent from 1931; operating expenses, $69,390,000, down 7.8 per cent; energy generated, 6,497,552,000 kw.-hr., down 6.8 per cent.

While operations continue to be less than in the preceding year, the disparity has been diminishing. This is not due to any unusual rise in 1932, but rather to the fact that in the fall of 1931 the increase in revenue was smaller than usual and the customary seasonal increase in kilowatt-hour production was conspicuously absent.

Compared with October, however, the revenue shows a gain of 2.5 per cent, while the average daily energy production went up from 212,000,000 kw.-hr. to 216,000,000 kw.-hr. In contrast with the latter the five-year average shows a slight decrease, the average since 1920 a 0.5 per cent increase.

One of the noteworthy differences between recent months of 1932 and 1931 has been the ratio between fuel-generated and hydro-electric output, due to the relief from drought conditions. This resulted in November in an increase of nearly 38 per cent in output from water power, whereby a saving of 24 per cent was effected in the amount that had to be produced from fuel. The former rose to 41 per cent of the total. In 1931 it constituted only 28 per cent.

As is evident from Table II, the revenue compared with 1931 was less, not only in the country as a whole, but in each geographical region considered separately. New England again reports the smallest decline, 4.3 per cent, followed by the Middle Atlantic region, 5.7 per cent. As in October, the largest decrease occurred in the South Central and Mountain regions. Some slight indications of improvement, or at least a cessation of the downward movement, are indicated in the returns from the important East North Central industrial area.

In the South Atlantic States water power supplied over three times as much energy as in November, 1931, with important gains also in several other regions and correspondingly large reductions in output from fuel.

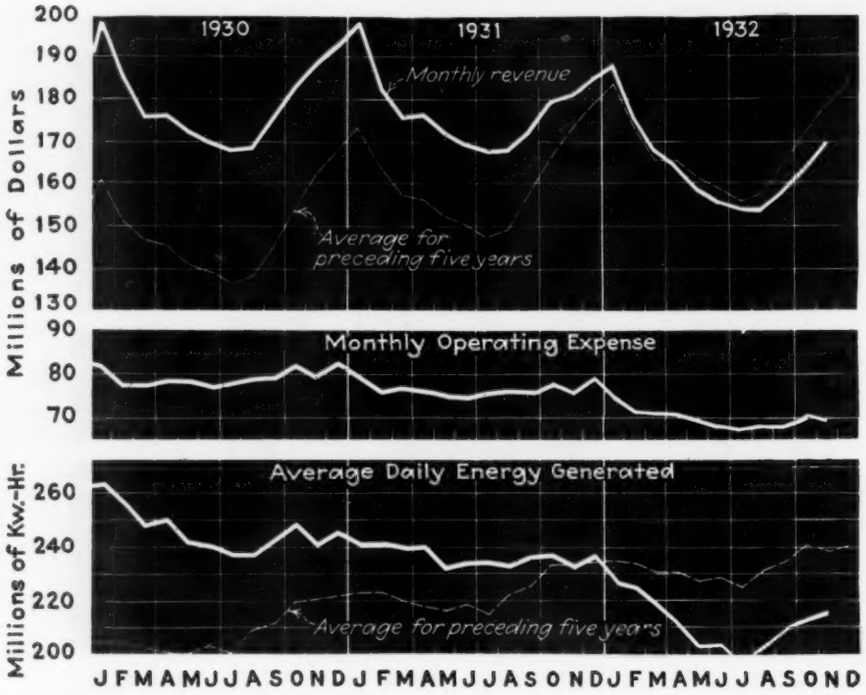


Table I—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1932	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
August	6,306,682	—12.0	2,383,784	+ 5.4	3,922,898	—19.9	1,840,000	— 1.2
September	6,297,221	—11.2	2,230,616	+ 9.9	4,066,605	—19.9	1,876,000	+ 1.0
October	6,588,393	— 9.5	2,498,670	+27.2	4,089,723	—24.1	2,044,000	+ 7.2
November	6,497,552	— 6.8	2,681,846	+37.8	3,815,706	—24.1	1,885,000	+ 3.5

Table II—Regional Operation, Revenue, Energy Output, in November, 1932

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	169,730	— 6.9	6,497,552	— 6.8	2,681,846	+37.8	3,815,706	—24.1
New England	18,180	— 4.3	462,890	— 1.7	283,260	+41.4	179,630	—33.8
Middle Atlantic	45,130	— 5.7	1,658,379	— 9.2	545,235	+36.2	1,113,144	—22.0
East North Central	39,770	— 7.4	1,497,667	— 8.2	153,618	—25.3	1,344,049	— 5.6
West North Central	14,180	— 7.1	412,924	—11.6	81,594	—29.8	331,330	— 5.7
South Atlantic	18,560	— 6.0	843,140	+ 6.0	565,800	+203.0	277,340	—54.6
East South Central	5,590	—10.1	269,469	+11.1	222,180	+65.0	47,289	—56.2
West South Central	10,200	—11.2	336,779	—13.3	4,756	+31.5	332,023	—13.7
Mountain	3,900	—11.3	178,874	—20.5	132,526	—17.7	46,348	—28.2
Pacific	14,220	— 7.5	837,430	— 9.2	692,877	+29.0	144,553	—65.2

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station operations.

Table III—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

Month	Total Gross Revenue from Sale of Energy*		Total Operating and Maintenance Expense†	
	1932 Thousands	Per Cent Inc.	1932 Thousands	Per Cent Inc.
August	$152,020	— 9.3	$68,370	— 9.5
Sept	159,040	— 7.5	68,410	— 9.1
Oct	165,410	— 7.4	70,060	— 9.1
Nov	169,730	— 6.9	69,390	— 7.8

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.

†Does not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions.

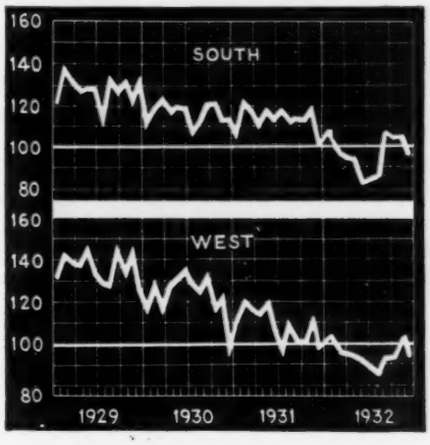
Industry, South and West Nearer Former Year's Level

Moving parallel with that for the country as a whole, the general industrial indexes for the South and West declined in December, but the decrease from November was much smaller than in 1931. The result was to bring the first named within 5.5 per cent of its value a year ago, whereas in November it was down 13 per cent. Similarly, the West is off 3.6 per cent, against 7.7 per cent in November.

In the South the iron and steel index, after a jump in September, continued its downward movement. Textiles, on the contrary, remained above the 1931 figure, as did paper and pulp, while chemicals and stone reversed the condition of November and are now higher than a year ago. Forest products and rubber dropped; the former 13 per cent under December of 1931 and the latter 57 per cent. Despite these losses the chart shows that the general trend during the past half year has been a rising one.

In the West the decline of 6.6 per cent from November was smaller than in any other year since 1927 and the trend since midsummer remains definitely upward. That has not been the case in any of the three preceding years.

Individual industries show little unity of movement. The food industry maintained the level of the two preceding months, but the index is nearly 16 per cent lower than a year ago. Forest products is up to the October figure, though off from November. The stone group and metals sagged less than usually though the latter is still very low.



Industrial Groups	South Dec., 1932	South Nov., 1932	South Oct., 1932	South Sept., 1932	South Dec., 1931	West Dec., 1932	West Nov., 1932	West Oct., 1932	West Sept., 1932	West Dec., 1931
All Industry	**94.5**	**104.4***	**103.8**	**108.5**	**100.0**	**94.7**	**101.3***	**96.8**	**96.0**	**98.3**
Chemicals	145.0	142.9	146.8	144.0	137.0	76.8	82.2*	86.0	84.2	88.3
Food	124.3	138.7	151.0	171.6	151.9	113.2	113.0*	112.0	120.0	134.4
Iron and steel	57.6	71.7	85.7	107.1	117.0	.....	.....	.....	.....	.....
Metal-working plants	54.5	61.7*	64.3	61.2	68.5	.....	.....	.....	.....	.....
Metals group	56.3	67.2*	76.2	87.0	104.3	38.6	43.1*	42.8	38.4	42.7
Forest products	38.7	51.4	50.5	44.1	44.6	133.2	145.7	132.8	121.2	124.8
Paper and pulp	143.0	157.5	145.0	142.2	96.6	125.5	141.7*	139.5	135.4	120.1*
Rubber products	30.6	78.8	78.6	86.8	70.9	50.2	62.5	75.8	84.5	53.7
Shipbuilding	.....	.....	.....	.....	.....	112.4	113.0	88.5	108.0	87.8
Stone, clay and glass	122.2	143.4	113.8	143.2	113.1	65.5	77.7*	71.3	81.3	79.0
Textiles	108.0	117.0*	107.8	105.3	102.8	.....	.....	.....	.....	.....

* Revised

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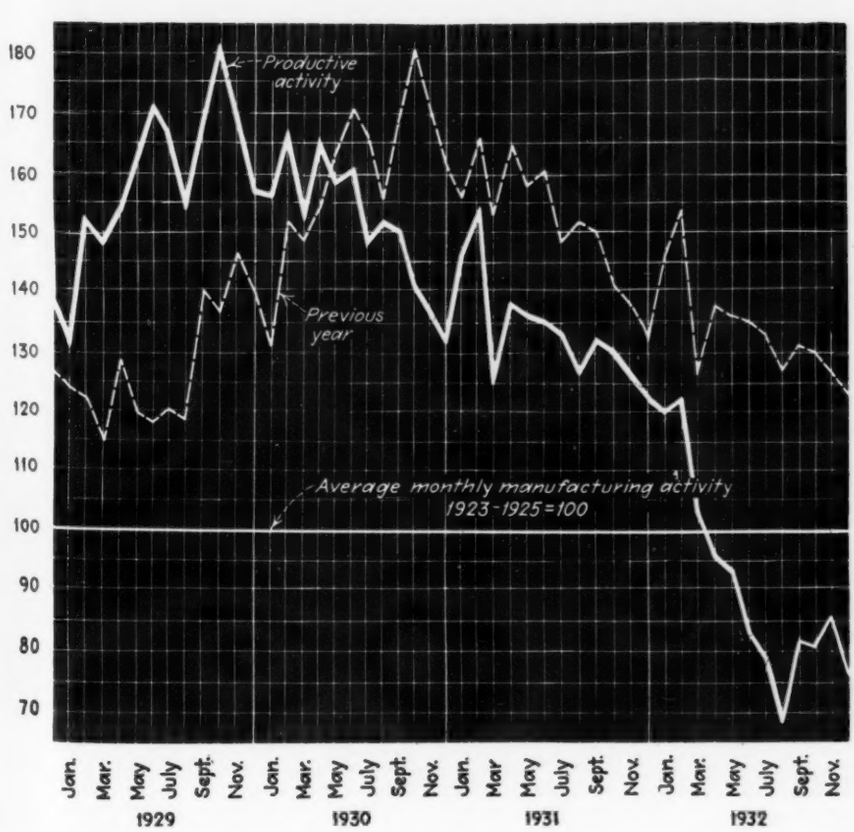
Electrical Goods Production Slackens



Much of the progress indicated by reports to the ELECTRICAL WORLD of energy consumption in electrical manufacturing during September, October and November was lost in December. The index of industrial activity, 76, was the lowest for any month except last August. There remains, however, a gain of 12.5 per cent compared with that month, in contrast with a very small one in 1929 and a decrease in 1930 and 1931.

In the East the returns show approximately the same energy consumption as in November, but the latter was a shorter working month, hence the average rate of operations was smaller in December. North Central operations were quite generally less than in November.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days
Base: Average Month, 1923-1925

Month	1929	1930	1931	1932
January	131.3	156.2	146.6	120.0
February	151.8	165.2	154.3	122.2
March	148.3	153.0	126.1	102.9
April	154.6	164.9	138.1	95.6
May	163.5	158.0	136.7	92.8
June	170.5	160.2	135.2	83.1
July	166.6	148.5	133.4	79.2
August	155.4	152.2	126.9	67.6
September	168.8	150.0	132.6	81.4
October	180.6	140.6	130.4	80.9
November	169.5	137.5	126.9	85.6
December	157.0	132.4	123.5	76.0

New Measure of Power Factor Accurate, Simple and Sound*

By ARCHER E. KNOWLTON
Associate Editor ELECTRICAL WORLD

Energy borrowed every cycle for excitation purposes should be rented along with sale of consumed energy. Metering of negative power loop readily accomplishes this purpose.

EXCESS capacity in equipment and lines required because power factor is less than unity is usually ascertained through the medium of the reactive or kilovolt-ampere meter. There is another way of metering for such excess capacity which seems not to have been given prominence in metering literature presumably because the means for metering has only recently been provided—contact rectification. Now that rectification has become so simple and accurate it is feasible to ascertain excess capacity for reactive loads by measuring either the positive or negative loops of the power wave in conjunction with the difference between them as registered by wattmeters and watt-hour meters. This procedure is seriously advanced for commercial consideration because (1) it is based on more real quantities than reactive metering, (2) it averts the inherent errors of practical reactive metering, (3) it affords a new index of power factor which makes it unnecessary to teach the lay power user trigonometry and vector analysis before negotiating power sales or power-factor correction with him.

The extent to which provision must be made for excess volt-ampere rating in system facilities and in utilization equipment as well, because reactive load and reactive circuits interfere with the full devotion of the capacity to useful power delivery, is measured by the product of volts and amperes without regard to phase.

While the designer often has considerable latitude in choosing the amounts of insulation, of magnetic core material, of copper coils and wires, container and frame weight and volume, he is held to obedience to the principle that voltage and current to a degree have independent influence on equipment and system investment. The common way of acknowledging this degree of independence is to assign to electrical equipment a volt-ampere rating in order to forestall overtaxing either its mechanical or electrical capabilities. This can happen by subjecting it to either or both overvoltage or overcurrent in the act of burdening it with excessive watt loading at low power factor. This is a wholly familiar practice and is cited merely to justify the prevalence of kilovolt-ampere metering and the slightly less direct but more common method of reactive kilovolt-ampere metering.

The niceties of vector analysis, on which reactive metering is founded, do, however, tempt the resort to the metering of quantities which have no such reality as the kilowatts and kilowatt-hours. The product volts × amperes admittedly has a high degree of economic reality; it has no physical reality. Only at unity power factor is there that simultaneity of instantaneous values of E and I, which warrants multiplying their effective values. At any other phase relationship the physical realities in the circuit and its terminal devices depart from the economic realities of designed capacity and the corresponding investment. The unreality of the metered quantities can therefore be attributed directly to the employment on a vector basis of non-simultaneous instantaneous values of current and voltage in an effort to

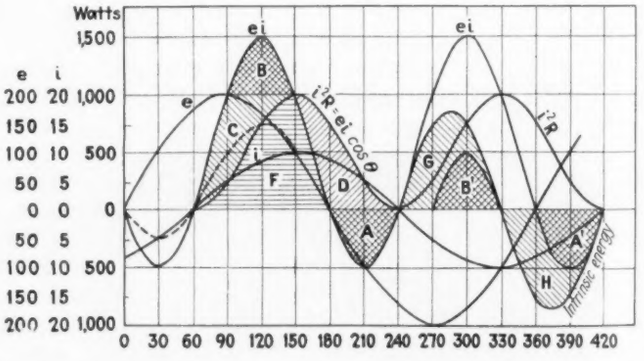


Fig. 1—Only part of the reactive component reciprocates as energy between alternator and reactive receiver

A sinusoidal voltage, e, sustaining a sinusoidal current i through a series circuit of inductive reactance and non-inductive resistance so proportioned as to make i lag e, in this instance by 60 deg. There are three realities here, the voltage, the current and the instantaneous energy flow at the receiver terminals. Within the receiver there are two other realities—(1) the storage in and recovery of energy from the magnetic region which constitutes the inductance and (2) the conversion of the energy in the receiver into heat, mechanical work, light, etc.

Often obscured by the too-ready acceptance of the vector concept of reactive volt-amperes is the fact that, although during the period from 60 to 150 deg. the receiver is here getting energy from the line, the energy is not being converted into heat, light or work as fast as it is being delivered to the receiver. While $e \times i$ during this interval exceeds i^2R, energy is being stored in the magnetic field of the inductance. This is represented by areas B + C. After $e \times i$ declines to equality with i^2R (at 150 deg. in this instance of 60 deg. lag), the energy being converted in the receiver is sustained by a transfer of energy D from the quantity stored in the inductance. This quantity D, identical with C, *does not return over the line to the generator.* After the initial transfer of this energy from the generator to set up the magnetic field it oscillates within the confines of the receiver, between its energy-converting and its energy-storing components.

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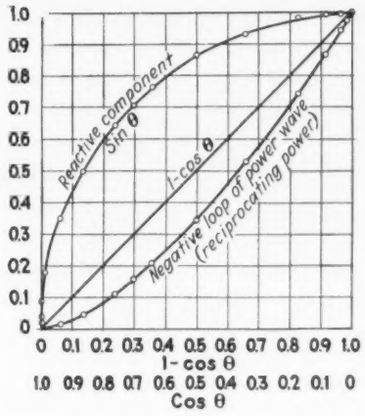


Fig. 2 — Reciprocating energy better index of excess capacity than the reactive component

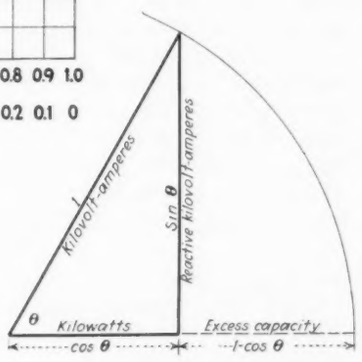


Fig. 3—Reactive kva. always exceeds the excess capacity

Fig. 4 — Negative power loop can be index of power factor

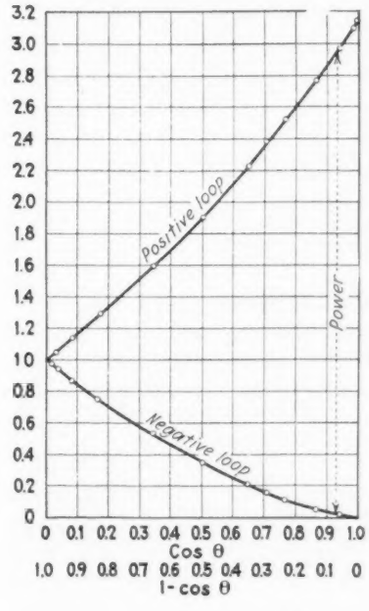


Fig. 5 — Half-wave rectification meters reciprocating energy flow

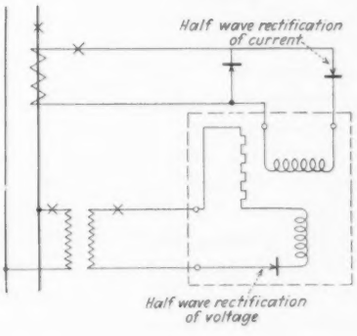
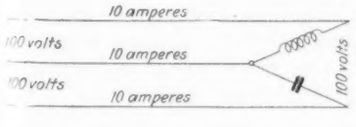


Fig. 6—No power, no reactive component, yet power factor is unity



A.I.E.E. definition and all practical polyphase metering schemes would in this case give zero watts, zero reactive volt-amperes, 1,730 total volt-amperes and unity power factor—incompatible results. Reciprocating energy metering as proposed would disclose the true situation.

reconcile the power and energy aspects of the situation with the economic aspects of the situation, governed as they are by widely different determinants.

It should therefore be permissible to dub reactive and kilovolt-ampere metering as merely economic expedients superimposed on a physical substantiality. Only simultaneous values of e and i are involved in the energy flow. As far as the physical phenomena are concerned, the maximum values of e and i are not simultaneous and there is no physical, even though there may be an economic, justification for multiplying the maximum (or effective) rather than the instantaneous values of e and i. Power factor is injected, of course, to scale such an unreal product down to reality. Whatever weakness of this character is manifested by the resort to the product of volts and amperes as an index of total volt-amperes is reflected in at least as great a degree (if not greater) by the reactive component volt-amperes.

A general but erroneous impression exists that the reactive kva. constitute a measure of that part of the *energy* which oscillates continuously between generator and receiver. Reactive kva. represent, however, that part of the *volt-amperes* which so oscillates. But energy is real and the volt-amperes are a fictitious product. As shown in Fig. 1, the energy which really reciprocates in the line is represented by the negative loop of the power wave and its positive counterpart.

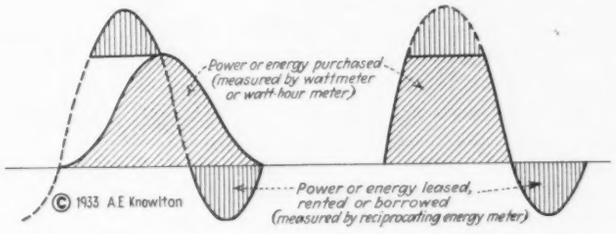


Fig. 7—Symbols of a new possibility in metering for excess capacity for reactive loads

From the standpoint of energy strictly, it is unreal therefore to attribute to the system the task of handling two components of volt-amperes, the in-phase and the quadrature, in order to reconcile the energy transfers with the economic commitments as to capacity. The reality in the situation is the flow of energy toward the receiver during the 60 to 150 deg. interval and the return flow of a needed but unused portion of that outbound energy during the interval 180 to 240 deg. This returned energy is not simply related to the reactive component ordinarily assumed nor is it linearly related to the scalar product of volts and amperes. It does, however, bear an orderly relation to the excess capacity required over and above that needed for delivery of the retained and converted energy $C + F$ or $F + D$ in Fig. 1. The relation of the reactive volt-amperes, $EI \sin \theta$, and of the negative loop of the power wave to $EI\ (1 - \cos \theta)$, a measure of the excess capacity necessitated by the inductive character of the receiver, is shown in Fig. 2. It is seen that the negative loop of the power wave $(\sin \theta - \theta \cos \theta)$ is much closer representation of the excess capacity than the reactive component.

That the excess capacity is represented by the factor $(1 - \cos \theta)$ is manifest from the familiar vector relation of voltage and current converted to kva. and kw. representation in Fig. 3. Another way of indicating the relation between the actual power, the positive loop of

the power wave and the negative loop of the power wave is shown in Fig. 4. The difference between the positive and negative loops, which is the true power (for any given values of E and I), is directly proportional to the power factor, of course, but neither the positive nor negative loop is in direct proportion to cos θ, or its complement $1 - \cos \theta$.

Nevertheless it should be possible to indicate both power factor and excess capacity requirements by metering either the positive loop or the negative loop in addition to the power metering as regularly done by the wattmeter. That neither quantity directly represents volt-amperes should be no deterrent. The reactive component $EI \sin \theta$ must be combined *vectorially* with the power component $EI \cos \theta$ to arrive at EI and this involves either the difficulties of the kva. meter or the errors and eccentricities of reactive metering under unbalanced* and non-sinusoidal conditions, both of which types of error are matters of common knowledge and at least abstract concern. Were it possible to meter directly either the negative or positive loop of the power wave this would at least eliminate all the errors due to unbalance because the measurement process would inherently associate each current with its own voltage in the polyphase case, whereas conventional reactive metering invariably associates a current with part, at least, of the voltage from some other phase.

The positive loop or the negative loop of the power wave can be measured independently of one another or of their difference (which is true power) by the simple expedient of half-wave rectification. Thus if an ordinary electrodynamic wattmeter or thermal wattmeter is subjected only to the negative values of voltage and the positive values of current it will develop torque only during the interval (180 to 240 deg. in Fig 1, for example), in which these specific polarities exist simultaneously. The meter will average the torques established in the A intervals, omitting those during the A' intervals because of the exclusion of the reverse polarities, plus of voltage and minus of current. This phenomenon can of course be compensated for by the calibration of the instrument to doubled values.

Basis of meter available

One means of setting up such a meter is indicated in Fig. 5. Subjection of the meter only to positive wave of both voltage and current would register the positive loop and be a similar index of excess capacity. At zero power factor the positive and negative loops are identical. At unity power factor the positive loop is identical with the true power and the negative loop vanishes. This elementary meter does not discriminate between lag and lead.

The virtue in measuring the negative loop rather than the positive loop rests in the fact that definite significance can be attached to it in commercial transactions involving power and capacity charges. The ordinary wattmeter registers the power which is *bought outright* by the consumer and the rectified-wattmeter registering the negative loop would give an index of the energy *borrowed, rented or leased* for excitation of magnetic or electrostatic elements of the receiver. At least this would resolve some of the lay ignorance about vectors, trigonometry and power factor into understandable terms of *energy used up* and *energy borrowed and returned.*

The anomalous case represented in Fig. 6 as a three-phase balanced voltage system applied to an open delta combination of inductance and capacitance of equal impedance is of interest in this connection. Power is zero and volt-amperes are also zero by applying the *A.I.E.E.* definition of polyphase power factor. Manifestly, however, the system volt-amperes are not zero and a generator of zero kva. would not suffice even though its prime mover would be of zero rating in the ideal case of loss-less generation. Conventional reactive metering would show zero reactive volt-amperes. A three-element meter with apposite rectification of volts and amperes of each phase as in Fig 5 would register absolutely the energy reciprocating in each phase between the reactive elements of the receiver and the generator. Its indication would be identical with the volt-ampere capacity necessitated at the generator under such zero-power factor load conditions.

Under the procedure here proposed the power factor concept could be visualized by the symbolic diagram Fig. 7, lifted out of Fig. 1 to form the trade-mark of a new commercial scheme for reconciling the metering technique with the energy economics of reactive loads.

See "Accuracy of Reactive Metering," ELECTRICAL WORLD, December 29, 1923, page 1309.

▼

Polar Intensity Curves Can Give Total Flux*

By EDWIN S. OBERNDORF
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One defect of customary polar representation of the distribution of light from concentrated sources is that a misleading notion of output and efficiency is likely to be obtained from the resulting areas. With the usual uniform scales for angles and candle-powers the areas are not proportional to the lumen output or the mean spherical intensity. This defect can be overcome by appropriate modification of both scales and the result is then that lamps with equal lumen output will be represented by polar diagrams of equal area.

The reason why the ordinary polar diagrams do not give significant areas is due partly to the fact that the method implies a spherical receiving surface, whereas the receiving surfaces are generally horizontal or vertical plane surfaces. Thus the uniform point source of one candle-power in all directions will provide 0.095 lumens in the 10-deg. zone adjacent to the vertical axis and 1.091 lumens in the 10-deg. zone just below the horizontal plane. The sectors on the polar curve, however, are of equal area instead of being in this 11 to 1 ratio of lumen output. Lights having their maximum intensity in the downward direction will be overestimated and those giving maximum values in the horizontal direction will be underestimated if areas are allowed to influence the judgment. The use of a uniform scale for candle-

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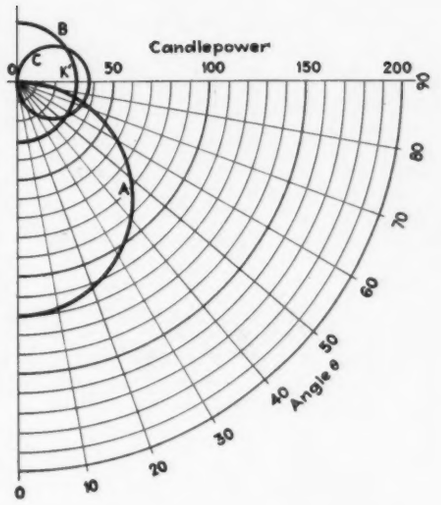

Fig. 1—Common polar diagram distorts lumen inferences

All three curves are for fixtures having a total lumen output of 377. A decrease to zero candle-power in the horizontal direction from 120 cp. in the downward direction. B has 30 cp. uniform intensity in all directions. C has a maximum of 38.2 in the horizontal direction but zero intensity up and down.

Fixture	Max. CP.	Curve Area Sq.In.	Total Lumens	Polar Equation of Curve
A	120	6.28	377	$\rho = \frac{I_0}{k'} \cos\theta$
B	30	1.57	377	$\rho = \frac{I_0}{k'}$
C	38.2	1.22	377	$\rho = \frac{I_0}{k'} \sin\theta$

in which k' = candle-power per inch of scale and I_0 is the maximum intensity of the fixture curve.

power also affects the relation between area and output, as obviously doubling the radius of a sector quadruples its area.

To make fixtures directly comparable by inspection and facilitate obtaining outputs and efficiencies the polar plot can be modified to produce equal areas for equal lumen outputs. First, the sector arcs are made proportional to the zones of the unit sphere at the corresponding

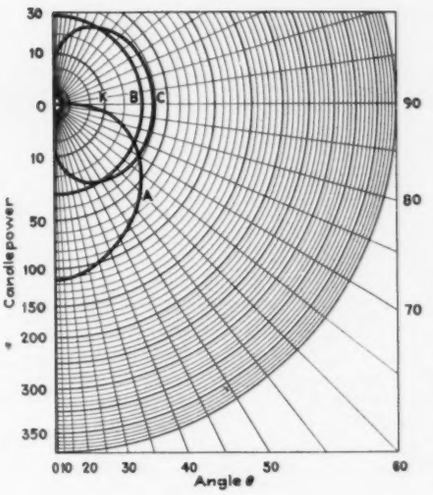

Fig. 2 — Lumens proportional to area in new polar plot

in which k' = candle - power per inch of scale and I_0 is the maximum intensity of the fixture curve.
The areas are 4.71 sq.in. for all three curves in the original drawing from which this cut was made. The corresponding polar equations of the curves are:

$$(A)\ \rho = \sqrt{\frac{I_0}{k}\left(1 - \frac{2\phi}{\pi}\right)} \qquad (B)\ \rho = \sqrt{\frac{I_0}{k}} \qquad (C)\ \rho = \frac{2I_0}{\pi k}\sqrt{\pi\phi - \phi^2}$$

where k is the lumen proportionality factor.

angles. Second, the candle-power scale is set up on a square root basis. The resulting scale for intensities being similar to a logarithmic one incidentally facilitates accuracy in reading because the smaller values are considerably extended. The angular scale is plotted on the relation $\varphi = 90° (1 - \cos \Theta)$; where Θ is the angle at which the light is emitted. The candle-power scale is plotted from the formula Radius $= \sqrt{k \times CP}$; where k is the candle-power at one such radius. That the resulting areas are equal may be seen from Fig. 2, which represents the same sources as plotted in Fig. 1. In plots made as in Fig. 2 the total lumen output of a fixture may be found by multiplying the area of the polar curve (on one side of the axis) in square inches by the factor $8k$.

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2,486 Companies for Electric Light and Power

Electric light and power companies in the United States having a generator rating of 500 kva. or larger number 978, and the inclusion of smaller companies and those operating solely on purchased energy brings up the total to 2,486, according to the latest listing in the McGraw Central Station Directory. The group having an installed capacity in excess of 50,000 kva. numbers 149 companies, but this group embraces by far the larger portion of the industry, for it probably corresponds quite closely with the major systems of the ELECTRICAL WORLD Supplement of May 7, 1932, which gives detailed data on the energy output of 142 such systems. These latter comprise 91 per cent of the total central station rating in the United States.

Somewhat more than half of the enterprises are municipal. This strikingly large number gives a distorted view, however, of the importance of those systems unless it is taken in conjunction with the fact that such enterprises are usually small. According to the Census of 1927 they had only 5.8 per cent of the total generator rating. The proportion has probably not changed very much in subsequent years.

Various classifications of companies and plants are presented in the accompanying tables.

Central Station Companies in United States

Operating Companies	
Subsidiaries	732
Independent	482
Municipal	1,272
Total number	2,486
Holding and management companies	194

Companies Classified by Generator Rating

Kva.	
Over 50,000	149
10,000 to 50,000	164
1,000 to 10,000	440
500 to 1,000	225
Less than 500	616
Undeterminable	42
Purchasing, no generators	850
Total	2,486

Number of Plants, by Type of Prime Mover

Water power	1,413
Steam	1,434
Oil engine	1,038
Gas	59
Unclassified	17
	*3,961

Number of Plants, by Generator Rating

Kva.	
Over 50,000	215
10,000 to 50,000	488
1,000 to 10,000	1,058
500 to 1,000	613
Less than 500	1,336
	3,711

* Includes duplications due to plants having more than one type of prime mover.

Molded Coating Halts Oil Pipe Corrosion

By ARTHUR J. SWANK

Construction Superintendent
Pacific Gas & Electric Company, San Francisco

WHEN new 220-kv. equipment was added to Newark substation last year a complete oil-treating system, consisting of a new treating plant and an underground oil piping network, was installed. Because a network of 1½-in. wrapped black iron pipe, handling the oil supply to other high-voltage switch equipment at this station, had been operating successfully for a number of years, 3-in. pipe of similar characteristics, but with welded joints, was selected for the new piping system. Buried underground, the new system was laid as a loop system for each group of oil-filled apparatus and connected with the old network. Ends of each loop, being brought to two pumping headers through a system of valves, permit the use of one part of the loop as a drainage for dirty oil and the other part as the supply line for clean oil. Details of the treating plant will not be described as this article deals primarily with the causes of the rapid deterioration experienced with the 8,000 ft. of 1½- and 3-in. pipe comprising this installation, its deterioration and curative methods which apparently have corrected this trouble.

A few months after completing the installation a serious oil leakage in the piping system was discovered when lowering the oil in a 220-kv. transformer to change the taps. Suspecting a defective weld or mechanical injury, the pipe was uncovered at the point of leakage. There a small hole, as if made by a pick, was discovered. Although this was welded, subsequent testing revealed leaks in other places. A general investigation then was made of various parts of the piping system, which revealed numerous leaks, a startling discovery in view of the satisfactory service record of the old network and the short time which had elapsed since installing the new.

First impressions pointed to electrolysis as the cause of the corrosion, although the only known point of contact to ground was the manifold connection to the grounded frame of the oil pump. At this point a potential difference of several millivolts was found with the current flow from the pipe to the grounding system. A further survey was made of the complete piping system, which, in the new section of the yard, was laid in trenches with the ground cables. In order to obtain the proper grade for drainage the depth of the pipe had been made to vary from 12 in. to 5 ft., this variation in depth causing the pipe to lay in both clay and adobe soil strata. It was found that these soil conditions produced galvanic action in which local currents, from the clay to the pipe, flow along the latter and discharge to the adobe and then return to the clay again. Most failures occurred near the grounded structures, which seemed to indicate a local action augmenting the corrosive action of the adobe-clay-iron combination.

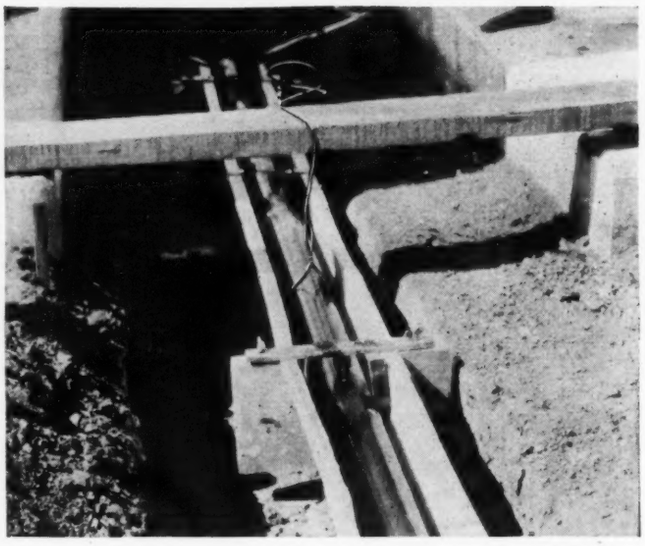

Fig. 1—Method employed in placing corrosion-resisting covering on oil supply piping

By suspending the pipe from the main crossbeam and hanging the mold directly on the pipe, as shown, irregularities in thickness of the molded coating, due to expansion of the pipe in contact with the hot material, are eliminated.

Tests, checking the current flow in the oil piping and in the surrounding soil, taken at a total of 30 points on the old and new networks and at several typical points on the water-piping system, revealed the following facts:

1. Oil piping in all sections, except one, was positive with respect to the soil.

2. The discharge (milli-ampere per square foot) was considerably greater in the new section than in the old section.

3. Excavations at places where the current flowing along the cables and pipes reversed in direction revealed that the tarred paper wrapping on the pipes was punctured by the bolts of the clamps on the cables. At these points the metallic connection between the iron pipe and copper cable formed a copper-iron couple which corroded the iron pipe very rapidly.

4. The natural corrosive action of the adobe-clay combination, considerably enhanced by the increased moisture in the soil due to the heavy winter rains, was aggravated further by the accidental iron-copper contacts. Removing all copper ground contacts to the pipe would reduce the corrosion, but would not eliminate it.

5. Attempts to drain the electric current from the pipes by discharging it from an auxiliary electrode would not be successful, as the current leaving the auxiliary

electrode enters the copper ground cable through the ground wells and then enters the pipe through the soil, affording the cathodic protection to the pipes, thereby corroding the copper cable. Thus no system of separate grounding could be devised without causing the corrosion of other cable or piping due to the adobe-filled electrolyte.

6. The only method left to protect the pipes was by placing them above the ground or incasing them in a waterproof insulation.

Due to the layout of the station yard, it was found impracticable to place more than one-half the oil piping above ground. Therefore, a study was started immediately to determine materials suitable for underground pipe protection and practical methods of their application. For the conditions under consideration, the protective coating must be impervious to moisture, be somewhat mastic and not subject to cracking, afford mechanical protection against puncture or crushing and capable of being applied economically. After consultation with the engineers of the Standard Oil Company it was finally determined to use "Somastic" asphalt, a product recently developed by that company which has been used with great success on its pipe lines.

Meanwhile, work had started in the field on the uncovering of all the underground oil piping. All of the lines were first cleaned of old asphalt and paper by hand, which proved the quickest and least expensive. Thousands of holes were found in the pipe, varying from small surface pits to holes of 1 in. diameter. After inspection and cutting out of worthless sections repairs were made by welding, completed runs were reconnected and all piping was tested with 90-lb. air pressure.

For the pipe which was laid above ground piers were precast with bolt inserts to hold wooden protective saddles. These piers were tamped in place to exact line and grade. After treating the wood saddles with "Pabco" preservative, they were bolted to the piers and the pipe laid on them. To provide for expansion, the pipe was anchored at approximately the center of each run, the ends being connected to risers from the underground sections with 3-ft. lengths of flexible, steel-interlocking tubing, thus permitting unrestricted movement of the pipe from the center to each end. The pipe was primed and both pipe and saddles were given two coats of aluminum paint. Ramps were provided at roads and sidewalks.

The underground sections were primed with asphalt paint and then coated with the "Somastic" mixture, an average day's work of 200 ft. of pipe requiring two 1-ton batches of material. A batch consisted of melted "Somastic" asphalt, two sizes of hot dry sand, hydrated lime and asbestos fiber, all carefully proportioned and mixed by hand in a heated open tank, using iron paddles. Three different mixtures were used, two of them being more or less experimental. Details of the mixtures are given in the accompanying tables.

Table of "Somastic" Insulation Mixture

*Batch	Mix A Weight Lb.	Mix A Per Cent	Mix B Weight Lb.	Mix B Per Cent	Mix C Weight Lb.	Mix C Per Cent
Gravel sand (Niles)	918	43.3	860	41.8	840	42.0
Bank sand (Antioch)	504	23.7	504	24.4	580	29.0
Somastic asphalt	320	15.1	320	15.5	300	15.0
Asbestos	18	0.9	18	0.9	20	1.0
Hydrated lime	360	17.0	360	17.4	260	13.0
Total	2,120	100.0	2,062	100.0	2,000	100.0

* Note—Mixing done on a volumetric basis, the quantities being determined from these batch figures.

Table of "Somastic" Insulation Application

Mix	3-In. Black Pipe Length, Ft.	3-In. Black Pipe Thickness, In.	1¼-In. Black Pipe Length, Ft.	1¼-In. Black Pipe Thickness, In.	Quantity of Mix Lb.
A	245	1¼	77	1	3 batches totaling 6,369
B	2,043	1¼	1,355	1	28½ batches totaling 58,767
C	61	1¼	67	1	1 batch totaling 2,000
Total	2,349		1,499		32½ batches totaling 67,127

Sheet-metal molds, bent in the shape of the letter "U" to give a 1¼-in. covering on a 3-in. pipe and a 1-in. covering on a 1½-in. pipe, were used. Molds were made up in 8-ft. sections and operations were carried out with the pipe in place in the trenches except for short sections which were treated above ground.

Two methods of application were used. With the first the metal forms were set under the pipe on wood blocks shaped to fit the form, alignment of the mold being maintained by small spacer blocks and removable sheet-metal top straps. The pipe then was suspended in the mold by means of wire hangers from timbers laid across the top of the trench. The hot compound was carried from the mixing vat in wooden buckets and poured into the molds by hand, the wooden spacer blocks being removed as the pouring progressed. Before hardening the top surface was smoothed with trowels.

This method did not prove successful on the long runs due to the unequal expansion of the pipe and the compound. As the heat was transferred to the pipe, it would expand and move away from the mold, displacing the spacers and top straps and causing unequal distribution of the mastic around the pipe. To correct this a second method was devised in which the molds were suspended from the pipe itself by making the form blocks to the exact size of the mold and replacing the sheet-metal top straps with heavy iron straps which were bolted to the blocks so that the mold and pipe moved as a unit (see Fig. 1). This also proved to be the more economical method as the mold was much easier to place and line up.

When the material had set the forms were transferred to the next section, a sufficient number of molds being on hand to permit a complete set twice a day. Joints between pours were lapped with an additional inch of mastic. All

Fig. 2—Placing the compound in the mold

Approximately 200 ft. of pipe a day can be treated in this manner.

suspension wires were cut off at the surface of the covering and sealed with an inch of mastic. As the runs were finished the pipe was lowered to a carefully sloped subgrade. Vertical risers also were covered for a distance of 4 in. above the ground surface to preclude corrosion.

Backfilling of the trenches was delayed until all the covering had been completed and the pipe subjected to final tests for oil tightness. This new piping system has now been in satisfactory operation for several months, although it is expected that several seasons will be required to give definite proof of the adequacy of the waterproof covering.

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Trend Continues Toward Automatic Regulation of Frequency*

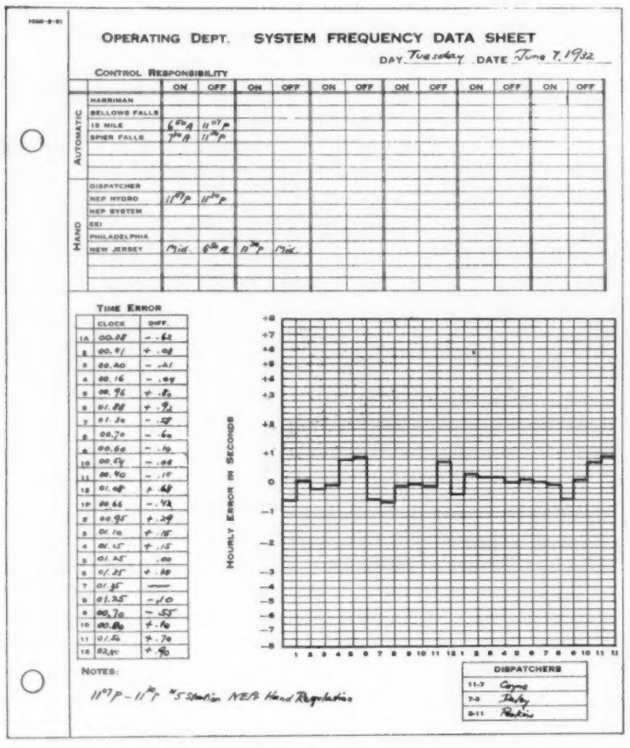
By R. BRANDT

New England Power Engineering & Service Corporation, Boston

— Time errors diminished.
— Power control aided.
— Interconnection technique improved.

LESS than six years ago the operating engineer faced the problem of determining what it was possible to do in the way of straightening the frequency chart line and holding the time error within reasonable limits. Today, with the help of available automatic equipment, tests and experience, the question is what should be done to satisfy the needs of customers, the requirements of system operation and of interconnection. Recent progress in New England has not been spectacular, but it has been steady. Our conclusion is unchanged that automatic equipment of one type or another is essential to satisfactory speed regulation. Hand regulation lacks the consistency of automatic apparatus and the task must be accomplished even if the efficiencies of individual plants have to be reduced in the interest of over-all improved service.

**From a paper before the systems operating committee, Pennsylvania Electric Association.*



Frequency log sheet used by New England Power System

Time error shown hour by hour in tabulation and plot; also periods at which control responsibility is lodged at specified plants of this and "foreign" systems.

Working toward 10 seconds accumulated time error

For some years there has been no difficulty in keeping frequency within the limits defined in industrial power contracts. To receive a complaint even from textile and paper companies, which require extremely high standards of steady speed, is rare. As regards synchronous clocks, considerable difference of opinion exists in the country as to what is a reasonable limit of error. Some systems have adopted 30 seconds, others as low as three or four seconds. Various causes are responsible for this. Time control is probably older than instantaneous speed control, and average time control is easier to maintain and imposes less excess cost on the controlling station or system because correction can be made more or less at leisure and requires less sudden swinging of load on the controlling plants.

Systems operating entirely on steam power supplied by a small number of large stations centrally located are usually to be found on the side of those who permit only the smallest of errors. Scattered hydro systems have been in the habit of making more liberal allowances. Looking toward the future, the reasonable attitude seems to be to determine just how much error is permissible and then to adjust the system operation to that standard. Within a comparatively few months the New England Power system standard has been reduced from 30 to 20 seconds and we have had no particular trouble in maintaining it. Only on two days since January 1, 1932, have we been up to this limit and the greater part of the time we are not over ten seconds away from standard time. I believe that eventually the 20-second limit can be reduced to ten seconds, but see no practical justification for going below this.

Steady frequency helps power control

Our major technical interconnection problem is making power flow in desired amounts at will; steady frequency aids this. It is not a complete solution of the

problem but furnishes a base on which we may hope to build some day to the final answer. We feel that a satisfactory standard of instantaneous frequency is one which hour after hour does not depart more than one-twentieth cycle, either up or down, from normal. It is impossible to say that the speed will never be out more than this amount and we do not claim to have continously maintained a frequency line within 0.05 cycle of normal. Usually when such an error does occur it is because the regulating plant or plants have reached the limit of their available range. We still have progress to make in the matter of dispatching so as to keep a range on our regulating stations which will at all times give them some slack before they reach their limits, either motoring or wide open.

Those of us who are normally interconnected have agreed that while one system is holding speed, the rest of us will hold tie line loads toward the speed control point. The confidence of the operator is developed if he sees that the frequency is steady when he is about to adjust a tie line load. If he finds the tie line is wrong while the speed is one-tenth or more out, he naturally hesitates to make the correction because he knows, or at least has been led to hope, that the speed will shortly be brought back to standard and he will have his tie line to correct all over again.

The drift which comes from allowing the speed to take care of itself for periods of 30 minutes or more is undesirable even though it reduces the swings on the regulating stations and their inevitable expense. Just as there is no definite money return on investment in voltage-regulating equipment, there is no specific reward for changing the load on a regulating plant to maintain a straight speed line. These are, rather, operating obligations.

Confidence in automatic equipment

We have had automatic frequency control equipment of two types in service long enough to have gained confidence in its ability to perform without excessive maintenance, and in the various plants in which it has been installed the operators take pride in the results they are able to obtain with it. We have been able further to dispatch our plants so as to permit the practically continuous automatic control of speed at some station or other on our system. In the first quarter of this year there were only two days out of each month when the speed was not under automatic control at all times, and then the periods were only of a few hours' duration. During the first three weeks of April, because our automatic equipment is in hydro stations only and our rivers were in flood, it was necessary on parts of five days to go either to hand regulation on our own system or to transfer control to another system.

We believe that future progress in general will be made (1) by improvement in the technique of our own operators and dispatchers and (2) by a reduction in the need for our own regulating plants to take such large load swings, which will come about by the widespread installation of automatic equipment on other systems which will either provide simultaneous speed control or some improved tie-line control.

In conclusion, mention should be made of the importance of adequate communication as a factor in speed control and power transfer. Much progress has been made here and more is still possible. This requirement is well understood and is being cared for. Again, the keeping of speed-control records is valuable. We employ a letter-sized sheet on which the time error is recorded and plotted from hour to hour, with space for comments which aid interpretation of the log. Finally, the satisfactory operation of interconnected groups would be impossible without co-operation and good will between all intercompany personnel and directing staffs. Frank discussion of problems and friendly working of interconnected systems lie at the bottom of the success attained.

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Lightning Shatters Concrete Pole Base

By J. ELMER HOUSLEY
Alcoa, Tenn.

Rather unusual damage to the concrete base of a steel tower resulting from a direct stroke of lightning is shown in the accompanying illustration. The concrete base measures 6x5x7 ft. and was broken along each center line. The two channel iron legs of the flexible type steel pole extend to the bottom of the concrete base

Steel in this footing was grounded

and each leg was connected to a heavy cable which was coiled in a bed of coke below the concrete.

One theory advanced is that streamer formation must have taken place within the concrete and volatilized sufficient water to raise the pressure to a disruptive value. The possibility of mechanical causation of the damage may be discounted because of the absence of strong winds during the storm. The tower line carries two three-phase circuits with conductors of 1,033,000-circ.-mil all-aluminum cable. No ground wire is provided. One insulator was broken. It is apparently necessary to provide paths having low values of resistance and impedance in shunt around and outside of the concrete bases of pole and tower structures in order to handle the currents of heavy direct strokes.

Special Power Tools Speed Transmission Line Erection

By W. B. FLYNN
Brookline, Pa.

Construction rate of 1.7 miles per day, including clearing of right-of-way, attained in building 70 miles of H-frame, 132-kv. line by means of power tools for clearing way, digging holes, framing, erecting and aligning structures and stringing and sagging conductors.

WITH continuing good weather, with no delays in material deliveries, with no hold-ups due to right-of-way squabbles and with all other factors and conditions propitious it is estimated that the use of power-driven tools can bring the cost of a 132-kv., H-frame transmission line to as low as $6,000 per mile. This estimated minimum is based on the experience of a utility in the Southwest in building 70 miles of this type of line. Features and details of the line are shown in the accompanying summary.

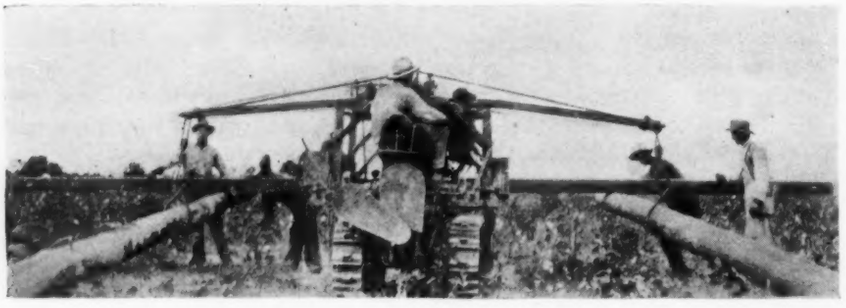
Construction Methods—The line passes through a slightly rolling, cultivated and wooded country with many deep gullies and steep grades. Only one-third of the route could be called flat country. The right-of-way easements, about 200 in all, were obtained in 24 days, using five agents. The first 15 miles of the line was released for construction on the second day, so there were no delays caused by right-of-way difficulties.

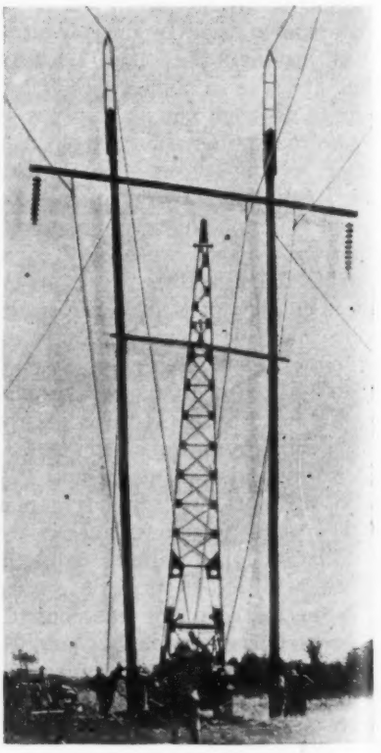
Clearing in the heavy timbered section was done with a power-driven saw mounted on a tractor. The saw is of the chain type driven through sprocket wheels geared to electric motors. Power for the motors is obtained from a small generator driven from the main tractor motor. A caterpillar crane, equipped with a grab bucket, followed the power saw and placed the fallen trees on the side of the clearing for trimming and disposal. The crane was also particularly useful in building a construction road along the clearing to be used in its own progress and later for the delivery of materials.

Framing the structures was done with a special tractor or "framing machine" equipped with three hoists, one of which is equipped with a movable boom and the two others with fixed booms, spaced 14 ft. apart, the pole spacing required for the H-frames. The fixed hoists are used to raise the poles to a convenient working height, while the movable boom is used to raise the crossarm and swing it into position. This machine made it possible to cut the erecting crews to but four men and one operator, a saving of six men per crew. The H-frames were completely assembled with bayonets, with static wires threaded through them, with insulators in the two outside phases and all power cables placed in position in their stringing blocks. The insulators for the middle phases were not attached at this time as they interfered with the hoisting equipment and were likely to be damaged during erection.

Structures assembled on ground with special framing tool

Two rigid booms on the sides for lifting poles and one movable boom ahead for handling the crossarms allow this machine to cut down the framing gang to four men.





The H-frame going up

The conductors are in the stringing blocks and the ground wires are in place. Trip lines, pulled from the ground, release the chains in the hoisting equipment when the poles bottom in the holes and avoid all need for climbing. The middle insulator is installed later at the time the conductors are sagged and clamped in.

This Is the Line Built with Power Tools

Length, 70 miles; voltage, 132 kv.; spans, 500 ft.; structures, H-frames of 55 ft., creosoted yellow pine poles on 14-ft. centers; crossarms, 6x8 in. x 29 ft. creosoted pine, 5 ft. below pole tops; conductors, No. 4/0 copper cable; insulators, suspension; ground wires, two ⅜-in. H.S. on 10-ft. bayonets giving 18-ft. spacing between ground wires and conductor cables, No. 4 copper ground lead on each pole, spiraled at butt, cross-connection of No. 4 "Copperweld" between ground wires at each structure; no protective gaps on crossarms nor on poles except at three-pole angle structures, which also have 9-ft. wood strain insulators in guys; spill gaps set at 26 in. at power station end and lightning arresters at substation end of line; performance—in service ten months, many thunderstorms, but no trip-outs due to lightning.

Frame erection was done with a 38-ft. boom portable crane or pole setter, using a heavy pipe spreader with bridle equipment. The spreader is attached to the poles with quick-release chain clamps which can be tripped from the ground so as to release the hoisting equipment. The entire assembled frame, with all five cables attached, was raised while the crew guided the butts of the poles into the holes. All holes were dug with highway type hole diggers.

Aligning and plumbing were performed with another special tractor. This equipment consists of a heavy cross-head equipped with special clamping heads. These heads are clamped to the poles and the whole H-frame can be raised or lowered one pole at a time or moved bodily as the cross-head is equipped to move in any direction. H-frame alignment was also done with the pole-setting equipment. However, the special equipment is quicker and more effective and saves about five men in the erection crew.

Cable stringing was done with a special tractor equipped with a structural frame arranged for mounting six cable reels. The five cables for this line were strung out on the ground in the clear at one time. The conductors and the static wires were shipped in equal reel lengths of 3,500 ft. After the frames were erected the cables were pulled to tension by means of the same machine, using a special equalizing device to insure equal tension in all three cables.*

Organization—The construction crews were divided into four groups, each under a superintendent: (1) Clearing, (2) material distribution, (3) line erection, and (4) automotive equipment repairs. Clearing was handled with three crews of twenty men each. Distribution of materials was handled with two gangs of about twenty men each. These men also installed the ground leads on the poles and assembled the bayonets at the yards before distribution to the line. Line erection was handled with a gang of about 75 men which carried the work through the first 50 miles of line and was supplemented at the latter part of the work by a second gang of 100 men brought in from other parts of the construction work during the final cleaning up of the job. The average rate of erection of the line, including clearing, was 1.7 miles per day.

Costs—With present-day prices of material and with normal labor rates (common labor 30 cents per hour, helpers 45 cents, linemen 70 cents, it is estimated that the above line could be built for $6,000 per mile, divided as follows:

	Per Mile		Per Mile
Materials	$3,000	Right-of-way	$300
Labor	1,000	Damages to property	150
Field supervision	250	General overheads	1,150
Surveys	150		
			$6,000

This estimate assumes copper at 10.6 cents, insulators at $1 and 55-ft. C.Y.P. poles at $23. These figures are given to indicate what such a line can be built for under ideal conditions of low material market, with no lost time and using power-driven tools throughout. Proper allowance should be made for the delays due to unreleased right-of-way, to deferred delivery of materials, to inclement weather and to other conditions so often unforeseen in transmission line construction.

Equipment Used in Building the Line

The distribution of materials required the following equipment:

2 ½-ton trucks for foreman and timekeeper.
3 Heavy trucks with trailers for distributing poles and cross-arms.
8 Medium trucks used as follows: One each for conductors, insulators, hardware, sand, two for miscellaneous and two for unloading poles from cars to trailers.
2 Caterpillar tractors for spotting poles on right-of-way.

The line construction required the following equipment:
1 Tractor saw for cutting heavy timber.
1 Tractor crane equipped with clamshell bucket for clearing right-of-way.
1 Tractor cable-stringing machine.*
1 Tractor cable stringing and sagging machine.*
1 Tractor framing machine.*
1 Tractor aligning machine.*
2 Tractor hole diggers.
1 Pole-setting frame with 38 ft. boom.*
3 ½-ton trucks for hauling men, building bridges, etc
7 Light automobiles for general use of mechanics, etc.
7 Automobiles for superintendents and inspectors.

*These special tools were all designed by the construction superintendent and built in the shops of the company.

Plant Power Factor Surveys Made With One Instrument

Plant engineers, in making surveys of load requirements to take advantage of power factor penalties or bonuses in the rate schedules, can obtain practically all essential information for the study by using a portable graphic wattmeter, an instrument which is usually available in most plants. In conjunction with a small and inexpensive auto-transformer for reactive kva. metering, the wattmeter may be connected so as to give a curve of reactive kva.-hours from which the day-by-day effectiveness of any power-factor corrective apparatus is apparent immediately.

As such a curve gives both the amount and duration of the reactive component of the plant load practical economics will dictate the capacity of corrective apparatus which will take full advantage of the rate without burdening plant investment with the costs of excess corrective kva. As most reactive-kva. meters for power

*See "Erecting Poles with Conductors Attached," by W. B. Flynn, "Electrical World," July 23, 1932, page 124.

company billing are equipped with ratchets to prevent reverse rotation excess corrective kva. will produce no benefit when the plant is operating with leading power factor unless a power-factor bonus is in the rate.

The reactive-kva.-hour curve not only gives a readily analyzed picture of the actual load conditions but also eliminates the use of intermittent voltage, current and power readings and the attendant calculations to obtain equivalent information.

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Simple Relays Given Precision by Resonant Circuits

By C. G. SUITS

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A fundamentally new method of relay design has recently been developed which employs resonant electrical circuits for their relay-like properties. These circuits act as control elements for the mechanical system, which may be of any type. The dependence for accuracy is thus placed on the permanent properties of an electric circuit quite independent of any uncertain mechanical factors. An accurate mechanical structure is a secondary consideration when this principle is used, so that a relatively crude contactor readily becomes a precision relay. The method leads to great economies in industrial control and the performance of hitherto impossible control functions such as multiple control over a two-wire system by variation of voltage.

Power may be taken from these critically resonant circuits at efficiencies of the order of 30 to 85 per cent for small loads without destroying the critical characteristics. This power may be supplied to a contactor which will close or open in response to the resonant or dissonant condition of the circuit. The series circuit of Fig. 1 is used for voltage relays and the parallel circuit for current relays.

The pick-up and drop-out points of these relays correspond to the resonant and dissonant voltages of the circuit. They are determined by electrical constants and are quite independent of armature wear and displacement. The drop-out is determined by the dissonant voltage, which may be adjusted independently of the pick-up by merely changing resistance.

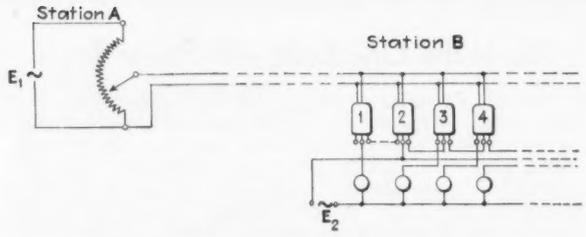


Fig. 2—Tele-control systems based on resonant circuits

The arm of the rheostat at station A is made to assume a position which depends upon the speed of a motor, the position of a gate, the pressure on a gage or some other variable. The voltage supplied to the two-wire system determines which of the resonant relays 1, 2, 3, 4 is selected and consequently which lamp is lighted to give the indication desired.

The pick-up and drop-out are both shifted to higher or lower voltage by taps on the inductance, the change being directly proportional to the change in the number of turns. When the resistance is large the pick-up and drop-out may be nearly identical to within a fraction of a per cent. To obtain this performance by other methods is practically impossible.

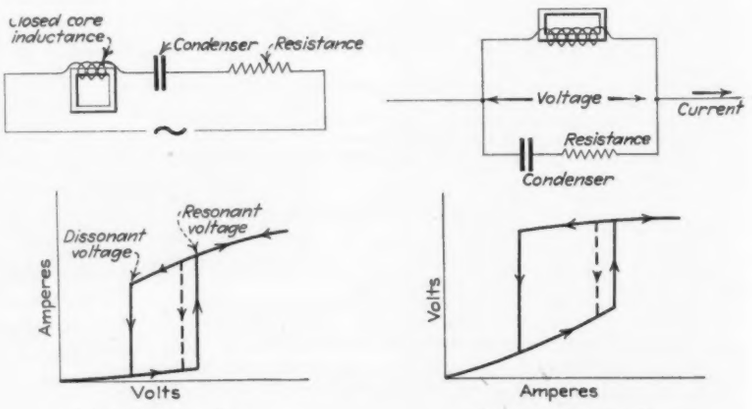
The control of a great many functions over a two-wire circuit is now accomplished by polarized d.c. relays (two functions), phase selective a.c. relays (two functions), frequency selective relays, coding relays, or by combinations of these methods. Certain classes of two-wire control which now require frequency relays and a variable frequency source may be accomplished with simplicity and economy with resonant relays and variable voltage.

The fundamental advantage of this method lies in the fact that variable voltage at constant frequency is much more economically obtained than variable frequency at constant voltage. In Fig. 2 is shown a simplified diagram of an indicator system employing resonant relays. As many as seven circuits have been operated between 110 and 130 volts in a laboratory set-up. The voltage E_1 must be supplied by a constant voltage transformer for this purpose. The power input to the selective system may be sufficiently small to transmit over many miles of standard telephone circuit.

Fig. 1—Resonant circuits actuate relays

Both the series and parallel circuit arrangements employ a capacitance, a resistance and an inductance with a closed iron core designed to saturate. When this saturation takes place, it is found that the resonant condition depends upon voltage and current in addition to frequency. In (a) as the voltage applied to the circuit is increased from zero, the current increases but little until the *resonant* voltage is reached, and then the current increases abruptly. If the voltage is then decreased the current will also decrease abruptly at some lower value called the *dissonant* voltage. The circuit thus has a volt-ampere curve that resembles the characteristics of a relay.

If the resistance is increased it is found that the dissonant voltage moves nearer the resonant voltage, which remains substantially unchanged in value. The dotted line in both figures shows this effect. A sufficient increase in resistance brings the dissonant voltage and resonant voltage together, resulting in a steep single-valued curve. Measurements have recorded a 100 per cent current change for a voltage change as small as 1/100th per cent.



Rewiring Drive Brings Results

By ROY A. PALMER
Illuminating Engineer Southern Public Utilities Company, Charlotte, N. C.

ELECTRICAL contractors at Spartanburg, S. C. (population 29,000), completed a seven-weeks' drive for modernizing home wiring about the middle of October which brought them a total of $5,084.12 worth of business. Five contractors participated in the campaign.

A prospect list of approximately 500 names was made up from the utility customers. These were checked from the standpoint of credit and correctness of addresses and all renters were eliminated excepting those who had lived in the same rented home for a period of six or more years. A letter was sent to each name on this list emphasizing the need for added outlets, switches, closet lights, etc., in the home. This letter was followed up by a personal solicitation by the contractor.

It was estimated that no more than five calls could be made each day, and if each contractor had 100 names on his prospect list it would require twenty days to complete his calls. If all of the letters were mailed at one time there would be too great a lapse of time between the receipt of the letter and the contractor's call. Therefore, it was arranged to mail letters to five names from each of the contractors' lists each day. The contractors were given a card carrying the name and address of each prospect on their list. The date of the mailing of the letter to that prospect was stamped on this card so that he could arrange to make his call shortly after the letter was received.

On this card also was a space for noting the work done for the prospect, the amount involved in dollars and cents for both labor and material, as well as space for any comment that the contractor may wish to make. When the work had been completed the contractor signed the card and turned it in to the secretary of the Electrical Association.

Further to pave the way for the contractor's call, a series of carefully prepared advertisements were run in the newspapers. These advertisements featured the advantages of modernized wiring in the home and carried the names and telephone numbers of each contractor.

At the end of the third week of the campaign the contractors had become so busy that they were unable to keep up with their calls and they requested that the mailings be held up. As a result the period of the campaign, which was originally intended to continue for six weeks, was extended an extra week.

To add interest among the contractors a friendly competition was arranged by giving an arbitrary number of points to those items which were being featured in the compaign. A new convenience outlet was rated at 25 points, a closet light at 30 points, etc. This system

Do You Have Plenty Of Outlets In Your Home?
THE convenience and comfort of your home is greatly dependent upon proper wiring.
Uneasy At Night?
Strange noises at night become less disturbing when one can turn on lights that illuminate the dark corners around the house.
Spartanburg Electrical Association
CLYDE L. ANTHONY
C. F. RUSSELL
J. FRANK BLAKELY
P. A. GEORGE
BOYD S. RANDALL
A
B

A—Emphasizes "The convenience and comfort of your home is greatly dependent upon proper wiring. An extra outlet here and there in various rooms will permit you to change the position of your furniture without hindering the usefulness of your portable lamps and appliances.

Two typical advertisements

B — Emphasizes — "Strange noises at night become less disturbing when one can turn on lights and illuminate the dark corners around the house. A convenient switch at the bedside and another switch downstairs to control outdoor lights. Light is the best policeman—it's always on the job. Darkness encourages intruders and crime...

also served to inform the group as to how the campaign was progressing without revealing the figures of the business secured by each individual contractor. Only the total dollars and cents of each week's business of the entire group was given out.

Booklets containing suggested rules for lighting the home were carried by the contractors to leave at each prospect's home. The offer to replace any existing single convenience outlet with a duplex outlet was stressed. This item could be priced attractively and gave an opportunity to get into the home. Once inside the door, it was much easier to note the need for a three-way switch in the dining room, a pilot-light for the ironing board, a new radio outlet, etc.

Of the total business secured, $3,020.23 represented the amount obtained for items listed on the score sheet. The balance, $2,063.89, was business secured directly as a result of the campaign activity, consisting of lighting fixtures, appliances, lamps, etc. The contractors were urged at the beginning of the campaign not only to sell rewiring, but to "sell 'em something else" while they had an opportunity to contact prospects.

Newspaper advertising stressed specially low prices predicting a probable rise in material prices and urged action while the prices were lowest in history. This brought in several prospects for minor rewiring jobs in stores and other places besides the homes. In several instances these jobs were worked into sizable proportions.

The fact that Spartanburg has suffered six bank

Point Scoring System

Spartanburg Electrical Association Campaign September 5-October 22, 1932
Total points scored in campaign, 17,103

	Points Credit		Points Credit
Duplex convenience outlet replacing single outlet	15	Refrigerator light	15
New duplex outlet...Each	25	Pantry light	25
Closet light...Each	30	Outdoor weatherproof receptacle	35
Garage light, basement light, or attic light...Each	20	3-way switch...Each	25
Pilot light	15	Single switch...Each	15
Protection light...Each	50	Door bells...Each system	10
Garden light, Jr. size...Each	40	Burglar alarm...Each system	20
Garden Light, Sr. size...Each	50	Attendance at weekly meetings	25
House number	15	Complete report of week's Activity	10
Floor outlet in dining room	35	Repairs or replacements...Each dollar of business	3
Combination radio outlet	20	Replacing open type entrance switch with safety type and bringing cut-in up to standard ...Each dollar	4
Kitchen unit replacing drop cord or bare lamp	20		
Light installed over sink	25		

Rewiring, new or old....Increased number of outlets merit award or points according to type and location of outlets (see schedule above).

failures makes the success of the campaign even more apparent. Moreover, the contractors report the collections excellent. They found people unwilling to have work done unless they had the money to pay for it. One contractor of the group felt that this could be explained by the fact that most people whom they contacted were of the type who now wanted to "pay as they go" rather than ask for credit, as they would have done unhesitatingly in the past.

Other benefits derived

While the contractors have brought more dollars to their own pockets in the past seven weeks than they would probably have done without the campaign, there are other benefits resulting from the activity. The theory that every home almost without exception needs more outlets, switches and other wiring, and that many home owners are cognizant of that fact and will buy if properly approached, has been substantiated as a definite fact in Spartanburg. *The contractors have also proved to themselves that to create business one must go out after it.* Newspaper advertising, mailings and similar promotion alone will not bring the business in from the home to the contractors' desks. Such activities only serve to make the selling easier. Footwork and personal solicitation are absolutely essential. With all the benefits which the contractors obtained from the campaign, it is obvious to any electrical man that the real and lasting benefits were secured by the contractors' customers, for the greater convenience, comfort and pleasure resulting from the added wiring will mean far more than the dollars which it cost.

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Behavior of Eye-Controlled Street Lights Satisfactory

Results obtained with the electric eye control of street lighting on the system of the Borough Electric Works in Wallingford, Conn., are reported by A. L. Pierce, general manager, to be wholly satisfactory. The photocell is mounted so as to get the early morning light from the east. It turns the lights on when the natural illumination drops to about 1½ foot-candles and turns them off when daylight is slightly above 1½ foot-candles. The cell controls directly two transformers which feed circuits radiating to different parts of the town. Cascaded relays then energize RO type transformers which serve the outer areas.

That the sensitivity of the cell is more than adequate is indicated by the experience during a severe thunderstorm when the street lights gave several pronounced "blinks" which were attributed to the response of the cell to the brightness of the lightning flashes. One decided advantage of the installation is the ease with which answers can be given to requests from attorneys as to the exact time of energizing the street lights on particular occasions involved in litigation. These requests are now answered by the simple statement that the street lights are on whenever natural illumination falls below 1½ foot-candles.

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BOOK REVIEW

What Is Technocracy?

By Allen Raymond. Published by Whittlesey House (McGraw-Hill), New York. 180 pages. Price, $1.50.

Ten times more lucid than anything the technocrats themselves have written or been quoted as saying, this book, one of the very first on the subject, tells whether Technocracy should be viewed as a bane or a blessing. It is written by the newspaper reporter who prepared the famous four articles in the New York *Herald Tribune*. Reporters look at things as the man in the street does and they habitually flavor events more with sense than with bias. That is the best testimonial possible for this lay interpretation.

Admittedly 90 per cent of the readers will get from the exposition a succession of violent "jars" (the four technocrats, strangely enough, happen to be Jones, Ackerman, Rautenstrauch and Scott, and a word picture of each is given, as should be the case with any cult-flotation like this). Complacency with the *status quo* will be rudely disturbed, but how tranquillity will be restored is left as much in the air by the author as by those who precipitated the excitement. The jargon of the technocrats is translated into English and all their astounding prophecy of either chaos or Utopia is set up for what it is worth.

If anything is really lacking in the book it is an understandable explanation why the "price system" and the gold basis must be scrapped just because machines and mechanical power have nearly eliminated human sweat from production. But the four technocrats do not make that clear, so how can the author be expected to do it, not having been seduced hook-line-and-sinker by their iconoclastic rejection of everything that is. In fact, he is disposed to be rather sceptical because he finds that much of the data shows signs of being fudged to prove what Veblen, Scott's mentor, said fourteen years ago about the desirability of replacing capitalism by a Soviet of engineers. The book in part answers its quizzical title, but it really tells only what Technocracy might possibly be as a new social order. That's perhaps all any sane person can do now.

Men of the Industry

M. L. Hibbard New President of Idaho Power Company

M. L. Hibbard, vice-president and general manager Idaho Power Company, Boise, since 1929, was elected last week president with the title of president and general manager by the board of directors. Mr. Hibbard has had a varied

career in the electrical industry, which commenced immediately upon his graduation from McGill University in 1906.

His activities included research work in the General Electric laboratories, free lance consulting engineering, constructing the street railway system in San Antonio, Tex., and holding various operating and managerial positions in Quebec, North Dakota and Minnesota. From 1923 to 1928 he was with the Northern States Power Company, Minneapolis, as assistant vice-president and chief operating engineer. It was in 1928 that he became identified with the Idaho Power Company as assistant general manager, advancing to general manager and the vice-presidency of that company on the resignation of W. R. Putnam, now of Electric Bond & Share Company. Since his residence in Boise he has held two terms as president of the Northwest Electric Light and Power Association.

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W. L. Willkie Named President of Commonwealth & Southern

Wendell L. Willkie was elected president of the Commonwealth & Southern Corporation at a meeting of the directors held this week. B. C. Cobb, who has been acting in the capacity of president as well as chairman, will remain chairman and chief executive of the company. Mr. Willkie has been a director and officer of the company and certain of its subsidiaries for the past year. In 1929 he became associated with Judge John C. Weadock in the firm of Weadock & Willkie, general counsel for the Commonwealth & Southern Corporation, and has been active in the company's affairs since that time. Mr. Willkie has retired from Weadock & Willkie to perform his new executive duties. Following graduation from law school he became a member of Mather, Nesbitt & Willkie of Akron, Ohio, and as such represented some of the most important utility, railroad, banking and industrial interests of eastern Ohio.

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WILLIAM BUCHSBAUM has resigned as a director and vice-president of the Associated Gas & Electric Company and affiliated companies with which he was identified. Mr. Buchsbaum has been associated with the public utility industry since 1901. He will devote his efforts toward the expansion of the activities of Barstow, Tyng & Company, Inc., of which he is a director and vice-president.

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OBITUARY

Edwin Gruhl

Edwin Gruhl, president of the North American Company, died suddenly, January 22, at his home in New York in his forty-seventh year. The selection of Mr. Gruhl for the presidency of this public utility holding company last spring followed the completion by him of twenty-one years of service. Starting in 1912 as assistant to the vice-president, two years later he became assistant to the president, in 1920 vice-president and in 1921 vice-president and general manager, a member of the executive committee and of the board of directors. At the time of his death he was an officer or director of approximately forty North American subsidiaries.

For many years prominently identified with the activities of the National Electric Light Association, Mr. Gruhl was a factor in creating the Edison Electric Institute, which was recently

formed following the dissolution of N.E.L.A. He had been named a member of the board of trustees of the new institute for a three-year term. He was an outstanding advocate of sound financial policies and good public relations and his untimely death is a great loss to the industry.

Mr. Gruhl was born in Milwaukee in 1886 and was graduated from the University of Wisconsin in 1908. In his senior year in college he was a member of the staff of the joint engineering department of the Wisconsin State Railroad and Tax Commission. After being graduated, he took charge of the statistical and research departments of the State Railroad Commission until 1911, when he joined the faculty of the University of Wisconsin, leaving after a year to join the North American Company.

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EDWARD A. MCCULLOCH of Little Rock, Ark., member of the Federal Trade Commission and formerly Chief Justice of the Arkansas Supreme Court, died in St. Louis, January 23, as the result of an operation. He was 71 years of age. Judge McCulloch was chairman of the Federal Trade Commission in 1929 and played an outstanding part in its work of investigating electric light and power companies. He presided over the utilities' hearings and supervised the formation of plans for that investigation. Born in Trenton, Tenn., he was educated in the public schools there and was admitted to the bar in 1883. In 1904 he became a member of the Supreme Court of Arkansas, of which he was Chief Justice from 1909 to 1927. In that year he was appointed a Democratic member of the Federal Trade Commission by President Coolidge.

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IRA W. MCCONNELL, formerly vice-president of Dwight P. Robinson & Company, construction engineers of New York, died of heart disease January 8 in Buenos Aires, Argentina. Until last winter Mr. McConnell had been not only vice-president of Dwight P. Robinson & Company, but he was also vice-president of United Engineers & Constructors, Inc., of Philadelphia. Less than a year ago he resigned his

positions with these companies to devote himself to the direction of the subway he placed in operation in Buenos Aires, as the representative of American banking interests. A graduate of Cornell University, he taught in that institution and at the Missouri School of Mines and spent six years in the United States Reclamation Service before joining the J. G. White organization. Later he was employed by the Stone & Webster Engineering Corporation as consultant in connection with the design, construction and operation of public utilities, railways, industrial buildings, etc. Mr. McConnell was 61 years of age.

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Leo M. Dunn

Leo M. Dunn, vice-president of the Graybar Electric Company, died January 20, at his home in Garden City, L. I., in his fifty-ninth year. On March 10 Mr. Dunn would have completed 47 years of continuous service

with the Bell System and Graybar Electric Company. After 24 years of service in the operating end of the telephone business Mr. Dunn joined the Western Electric Company in 1910 as chief storekeeper at Pittsburgh, subsequently becoming manager and later manager in Philadelphia. In 1918 he was appointed assistant eastern district manager, and was transferred in 1921 to New York as manager. Later that year he became eastern district manager, and in 1923 was made general merchandise manager of the entire Western Electric supply department. When the Graybar Electric Company was formed, in 1926, Mr. Dunn was made a vice-president.

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WILLIAM H. BOLEWINE, for nearly 25 years superintendent of transmission and distribution for the United Electric Light Company, Springfield, Mass., died January 13 in Springfield. He was born in Rochester, Minn., in 1867 and for a time was employed by the Boston Edison Company prior to locating at Springfield in 1908.

New Equipment Available

Round-Chart Micromax Indicating Recorder

Leeds & Northrup Company, Philadelphia, has placed on the market a new round-chart "Micromax" indicating recorder. The low-cost dependability is especially valuable in pyrometers of 400 to 900 or 1,000 deg. F. range, because three of the micromax advantages have great appeal in processes that use those temperatures. These advantages are, first, the temperature detector, thermocouple or resistance thermometer, has extremely long life; second, it may be replaced when necessary without sending the recorder back to the factory, and, third, it may be installed at any distance from the indicating recorder or shifted from place to place at will.

Some of the features are: It has a boldly lettered circular scale that can be read at a glance across a large room, uses a 24-hour circular chart, which has straight-line time co-ordinates instead of curved ones, thus further increasing the readability, and is one of the few round-chart recorders with such co-ordinates. The calibrated portion of the chart is 3½ in. wide and the chart is 10⅜ in. in diameter over all.

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ANNOUNCEMENT OF A PHOTOELECTRIC RECORDER which is extremely sensitive, obtained primarily by the use of photoelectric and pliotron tubes, has been made by the General Electric Company. This instrument requires no batteries for its operation. The plate, grid and filament supply for the photoelectric and pliotron tubes is normally furnished by rectified 60-cycle, 115-volt alternating current. It can be furnished to operate on a circuit of any other standard frequency or voltage.

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A POSITIVE PRESSURE FUSE CLIP which lowers heating at the contact between clip and fuse by 60 per cent has been placed on the market by the Square D Company, Detroit, Mich. The clip is made of pure copper, which results in higher electrical conductivity. The reinforcing steel spring, which is rustless, insures long contact life and positive automatic gripping of the fuse without auxiliary parts, it is claimed.

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HIGH FURNACE TEMPERATURES, as in hardening, billet forging, preheating, melting and electric hydrogen furnaces, can be recorded and controlled with sustained accuracy, it is claimed, by a "Pyro" radiation tube placed on the market by the Pyrometer Instrument Company, New York. It is also possible, in many instances, to record and control the temperature of the material itself, an important feature. If for any reason it is desired to regulate flame temperatures, it is advisable to build into the combustion chamber a closed end ceramic tube into which the instrument is sighted.

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Pipe-Ventilated Motors

The Ideal Electric & Manufacturing Company of Mansfield, Ohio, has announced the development of a new motor especially designed for the unusually severe service encountered where the motor is exposed to excessive humidity, high temperature, abrasive particles, heavy dust, etc. The Ideal pipe-ventilated motor is a totally inclosed polyphase squirrel-cage induction motor, ventilation being supplied by a large centrifugal fan which draws cool clean air in at one end and discharges the warm air out of the other end.

These units are supplied to meet all torque and inrush classifications for both squirrel cage and slip ring induction motors from 1 to 200 hp., including across-the-line start motors in all sizes up to 200 hp., and are for two or three-phase, 25, 30, 50 or 60-cycle current and all voltages up to 2,300.

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ELECTRONIC TUBE CONTROL has been applied to the Berwick forging heaters of American Car & Foundry Company (ELECTRICAL WORLD, December 31, page 896). Here the electric eye operates a relay which, in turn, causes the mechanical movements of the electrodes to function. Advantages are seen as close control of temperature, within about 10 deg., and fully automatic operation.

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THE BLAW-KNOX COMPANY of Pittsburgh has added to its line of steam power equipment a desuperheater, based on a new principle, which embraces in one piece of apparatus complete desuperheating with steam purification. While the design is new in desuperheating, the main parts have been amply proved in standard equipment over a long period of time. The desuperheater consists of a Blaw-Knox contactor combined with a "Tracyfier," steam purifier, and equipped with a standard make of boiler feedwater regulator.